Claim 4 has only been amended to remove an example of the to electrical load. Claims 5-10 have only been amended to refer to the microwave power source, power converter, and radio and microwave generator of claim 1 in order to provide antecedent basis. None of these amendments were made overcome prior art or to limit the claim scope thereof in any way. The doctrine of equivalents applies fully to all claims. No new matter has been added.

The Examiner's rejections of claims 4-10 at paragraph 5 on page 6 of the Office Action are mooted by the above amendments. Accordingly, withdrawal of the rejection of claims 4-10 is respectfully requested.

Claims 1-209 stand rejected under 35 U.S.C. §§ 101 and 112, first paragraph (112-1). Applicant respectfully submits that these rejections are based upon an erroneous assertion that Applicant has provided insufficient evidence establishing the existence of novel hydrogen species having lower-energy states, i.e., "lower-energy hydrogen," and, therefore, that Applicant's claimed invention based on that technology lacks utility and is nonenabling.

As demonstrated below, Applicant's disclosure of his novel hydrogen chemistry fully meets the utility and enablement requirements of 35 U.S.C. §§ 101 and 112-1, as confirmed by the extensive experimental evidence submitted by Applicant. Therefore, the Examiner's rejections under Sections 101 and 112-1 are erroneous and should be withdrawn to allow the claims to issue.

Should the Examiner, however, maintain the present rejection of claims, Applicant requests withdrawal of the finality of the July 29, 2002 Office Action and a personal Interview with the Examiner for the reasons stated below.

The Examiner Has Misconstrued Applicant's Experimental Evidence

Applicant acknowledges and appreciates the extent to which the pending Final Office Action, in reply to Applicant's January 28, 2002 Response, clarifies the previous positions taken in the July 26, 2001 Office Action. The Final Office Action begins with the following summary of Applicant's January 28 Response:

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> [Applicant] made an in-depth analysis of the rebuttal of the rejection of the claims and pointed out the errors in the thinking of the Examiner as to the rejections in question.
>
>   * * *
>
>   The Applicant argued that the theory is substantiated by <u>compelling experimental evidence</u> which confirms the existence of a lower-energy hydrogen as carried out and presented by the Applicant (see "Response to the Office Action," pages 22-23). The Applicant construed that the Examiner did not analyze the experimental data as he mentioned (see "Response to the Office Action", page 3, lines 13-22) which is not the case. [Final Office Action at p. 2 (emphasis in original)]

The above-cited passage of Applicant's January 28, 2002 Response contained the following quote from page 2 of the July 26, 2001 Office Action, which Applicant interpreted as an admission by the Examiner that she failed to consider the experimental evidence submitted in support of the existence of lower-energy hydrogen:

> The data presented in the Experimental section is not conclusive. Its analysis and any judgment upon its significance is outside the scope of the Examiner. [January 28, 2002 Response at p. 3]

Based upon this perceived admission, Applicant properly concluded that the Examiner "did not properly consider Applicant's disclosure and supporting experimental evidence" in rejecting Applicant's claims. <u>Id</u>.

In the pending Final Office Action, the Examiner clarifies his previous remarks, now claiming that she did analyze Applicants scientific data:

> In fact the Examiner did scrutinize the data and found an overwhelming amount of repetitive theoretical description, but found the <u>compelling experimental evidence</u> to be inconclusive as presented. It is the Examiner's opinion that the demonstration of the existence of a novel hydrogen species having lower energy states is best demonstrated by a shift in the Lyman series lines towards the far ultra-violet. This data should be compared to the regular hydrogen series. Unfortunately, this analysis and data is missing in the Applicant's experimental evidence presentation. [Final Office Action at p. 2 (emphasis in original)]

While Applicant appreciates the Examiner's views on the spectroscopic data, which serve to advance prosecution of this application, Applicant fails to

understand why these helpful comments were not presented earlier in the first Office Action. The Examiner's prior statement in that Office Action that such "analysis and any judgment upon its significance is outside the scope of the Examiner" certainly conveyed to Applicant that his experimental evidence had been ignored. If that was not the case, the Examiner should have stated as much and identified the alleged deficiencies associated with Applicant's submitted evidence in the first Office Action, instead of waiting until the Final Office Action to do so.

Nothing in Applicant's prior Response to that first Office Action—certainly not the criticism of the Examiner's failure to analyze Applicant's scientific data— justifies the Examiner's delay in presenting that analysis. Simply put, it is unfair for the Examiner to claim she considered Applicant's evidence in the first Office Action, but to wait until the Final Office Action to comment upon it. Therefore, in the unlikely event that the Examiner is not persuaded by the present Response to the merits of the Examiner's untimely final rejection, Applicant kindly requests that the finality of the present Office Action be withdrawn.

Incredibly, in the pending Final Office Action, the Examiner still fails to analyze the vast body of other experimental evidence that Applicant submitted to confirm the existence of lower-energy hydrogen. Instead, the Examiner provides only vague comments characterizing Applicant's "compelling experimental evidence to be inconclusive as presented." [Final Office Action at p. 2] While Applicant strongly disagrees with that characterization, it leaves Applicant to wonder why is that compelling evidence inconclusive as presented? How could that evidence, or some other scientific data, be present differently to be more conclusive? Absent that analysis, Applicant has not been given a fair opportunity to address the Examiner's concerns.

Even in the Examiner's limited consideration of Applicant's spectroscopic evidence, the Final Office Action contains significant gaps in the analysis of Applicant's experimental evidence. The Examiner, while claiming to have considered that evidence, fails to articulate any specific reasons for rejecting its validity:

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The Applicant claims (see page 26, lines 9-26; and page 117, lines 26-33) that the release of energy from hydrogen as evidenced by the extreme ultra-violet (EUV) emission must result in a lower energy state of hydrogen. The Examiner considered the evidence, but questions the validity of the experiments and why this EUV emission was not previously observed. [Final Office Action at p. 3]

For the Examiner to simply state that she has "considered the evidence," but questions its validity, without providing any explanation for his reasoning is not only unhelpful, but unfair. Again, such an approach provides no opportunity for Applicant to address the alleged deficiencies perceived by the Examiner. It obviously would be extremely helpful if the Examiner would explain, in detail, why she questions the validity of the experiments. Without an understanding of the basis for the Examiner's skepticism, Applicant is at a distinct disadvantage in his attempts to convince the Examiner otherwise.

As stated in Applicant's previous Response, the Examiner has the initial burden of showing that Applicant's lower-energy hydrogen technology is "not supported by a credible asserted utility or a well established utility." [January 28, 2002 Response at p. 2] To meet that burden, it is simply not enough for the Examiner to conclude at the outset that the assertion of utility of Applicant's claimed invention is not credible, without considering and evaluating the evidentiary basis for that assertion on the record. But that is exactly what the Examiner has done. *Indeed*.

To meet that burden, it is not sufficient for the Examiner to simply conclude, without explanation, that she has analyzed the evidence, but considers it invalid. Clearly the Examiner must do more than that. [See January 28, 2002 Response at pp. 1-4, *citing* MPEP § 2107.01, pp. 2100-31 ("A conclusion that an asserted utility is incredible can be reached only after the Office has evaluated both the assertion of the applicant regarding utility and any evidentiary basis of that assertion") (emphasis added)]

Yet, according to the Examiner:

The burden of proof rests with the Applicant in that he has to show to the Examiner that the experimental evidence demonstrates the

existence of a novel hydrogen species and compositions of matter comprising new forms of hydrogen which is based upon the bindng energy being greater than that for normal hydrogen. [Final Office Action at p. 3]

The problem with that statement is that it ignores the Examiner's initial burden to articulate a good faith basis for questioning the validity of Applicant's experimental evidence. Applicant believes he has shown how the experimental evidence demonstrates the existence of lower-energy hydrogen and compositions of matter comprising this new form of hydrogen. To place the additional burden on Applicant to anticipate and address the Examiner's reasons for questioning the validity of that evidence creates a new standard of patentability that is blatantly unfair.

The Examiner creates yet another new standard in questioning "why [the] EUV emission [of lower-energy hydrogen] was not previously observed." [Final Office Action at p. 3] In doing so, the Examiner has unfairly penalized Applicant for being the first to invent his novel hydrogen chemistry.

The fact that the EUV emission of lower-energy hydrogen was not previously observed and recognized merely provides further evidence that Applicant's claimed hydrogen technology satisfies the novelty requirement for patentabiity. To then use that fact as an excuse for dismissing Applicant's spectroscopic data, which confirms the existence of lower energy states of hydrogen, is to turn the standard of patentability on its head.

Regarding the merits of the Examiner's new, albeit limited, analysis of Applicant's spectroscopic data, that analysis raises two basic points of disagreement. First, the Examiner mistakenly states that Applicant's data demonstrating the existence of lower-energy hydrogen, as "best demonstrated by a shift in the Lyman series lines," is missing a comparison of those lines to the lines of the "regular hydrogen series." Applicant, however, has already provided that conclusive spectroscopic data and, in response to the Examiner's characterization of that data as the "best" evidence, provides further comparative data for the Examiner's consideration. Much of that scientific data can be found

in published, or soon to be published, peer-reviewed articles appearing in prestigious scientific journals.

Second, while Applicant agrees that this spectroscopic data is highly probative on the issue of lower-energy hydrogen's existence, that evidence should not be analyzed to the exclusion of other probative data submitted on that same issue. Once again, Applicant has supplemented that evidence in this Response with the expectation that the Examiner will fully and fairly consider it and, if found deficient, provide adequate feedback to allow Applicant an opportunity for rebuttal.

A complete discussion of these points can be found below. Applicant is confident that once the Examiner fully considers and analyzes all of the experimental evidence of record, including the spectroscopic data that compares the Lyman series line shift between lower-energy hydrogen and ordinary hydrogen, she will conclude that the present claims drawn to Applicant's novel hydrogen chemistry comply with the requirements of 35 U.S.C. §§ 101 and 112-1 and, therefore, should be allowed.

Request for Interview

To assist the Examiner in considering Applicant's experimental evidence, and to further explain aspects of its significance, Applicant kindly requests the courtesy of a personal Interview to be scheduled at the Examiner's earliest convenience. Applicant believes that this Interview would be extremely helpful in advancing the prosecution of this application, especially given the nature of the Examiner's recent comments contained in the July 29, 2002 Final Office Action recognizing the probative value of Applicant's spectroscopic data.

The Experimental Evidence of Record, Along With the Additional Evidence Submitted Herewith, Confirms the Existence of Lower-Energy Hydrogen

Applicant has now authored 86 technical papers that disclose millions of dollars worth of experimental data confirming the existence of lower-energy

hydrogen. 41 of these technical papers have been published, 36 of have been submitted for publication and 9 are in press. All of these papers either have been or are in the process of being reviewed by highly qualified Ph.D. referees and editors.

Included among the prestigious publications that have peer-reviewed and published, or accepted for publication, Applicant's technical papers are:

Journal of Applied Physics;

Canadian Journal of Physics;

Chemistry of Materials;

Applied Physics Letters;

New Journal of Physics;

Vibrational Spectroscopy;

IEEE Transactions on Plasma Science;

International Journal of Hydrogen Technology;

Electrochimica Acta;

Journal of Quantitative Spectroscopy and Radiative Transfer;

Journal of Molecular Structure;

Journal of Plasma Physics; and

Journal of New Materials for Electrochemical Systems.

In addition, Applicant's novel hydrogen technology was recently evaluated by NASA. [Attachment 1]

The attachments 1-80 to this Response include these published articles and NASA report.

Applicant can also point to other positive indicators, including the presentation of his experimental data in other venues, which has resulted in the issuance of patents on his lower-energy hydrogen technology in the U.S., Canada, Russia, South Africa, Australia, China, Eurasian, OAPI, and Turkey. Applicant expects additional patents to issue in numerous other countries.

The Spectroscopic Data

As noted above, Applicant appreciates the Examiner's recognition that his spectroscopic data can be used as a "demonstration of the existence of a novel hydrogen species having lower energy states" and that this is "best demonstrated by a shift in the Lyman series lines towards the far ultra-violet." [Final Office Action at p. 2]

In response to that recognition, Applicant provides the following supplemental discussion and analysis of spectroscopic data, including comparisons between the spectra of lower-energy hydrogen and ordinary hydrogen. This data demonstrates conclusively that the existence of lower-energy hydrogen is not only a theoretical possibility, but is in fact a reality.

Experimental Confirmation of Novel Lower-Energy Atomic Hydrogen by Extension of the Rydberg Series of Spectral Lines into the Extreme Ultraviolet

The lower-energy atomic hydrogen (also referred to as "increased binding energy hydrogen" since the lower energy state results in a higher binding energy) was conclusively identified by extreme ultraviolet (EUV) spectroscopy conducted in numerous tests, some of which are disclosed in ten technical papers.[1] The

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[1] R. Mills, P. Ray, "Spectral Emission of Fractional Quantum Energy Levels of Atomic Hydrogen from a Helium-Hydrogen Plasma and the Implications for Dark Matter", Int. J. Hydrogen Energy, Vol. 27, No. 3, pp. 301-322. **Attachment 55**

R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "New Power Source from Fractional Quantum Energy Levels of Atomic Hydrogen that Surpasses Internal Combustion", J Mol. Struct., Vol. 643, No. 1-3, (2002), pp. 43-54. **Attachment 50**

R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "New Power Source from Fractional Rydberg States of Atomic Hydrogen", Optics Communications, submitted. **Attachment 48**

R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "Spectroscopic Identification of Transitions of Fractional Rydberg States of Atomic Hydrogen", J. of Quantitative Spectroscopy and Radiative Transfer, in press. **Attachment 49**

R. L. Mills, P. Ray, J. Dong, M. Nansteel, B. Dhandapani, J. He, "Spectral Emission of Fractional-Principal-Quantum-Energy-Level Atomic and Molecular Hydrogen", Vibrational Spectroscopy, in press. **Attachment 33**

R. L. Mills, P. Ray, B. Dhandapani, J. He, "Energetic Helium-Hydrogen Plasma Reaction", AIAA Journal, submitted. **Attachment 10**

R. L. Mills, P. Ray, B. Dhandapani, J. Dong, X. Chen, "Power Source Based on Helium-Plasma Catalysis of Atomic Hydrogen to Fractional Rydberg States", J. Mol. Struct., submitted. **Attachment 12**

R. L. Mills, P. Ray, B. Dhandapani, J. He, "Extreme Ultraviolet Spectroscopy of Helium-Hydrogen Plasma", IEEE Transactions on Plasma Science, submitted. **Attachment 16**

R. L. Mills, P. Ray, B. Dhandapani, J. He, "Emission Spectroscopic Identification of Fractional Rydberg States of Atomic Hydrogen Formed by a Catalytic Helium-Hydrogen Plasma Reaction", Vacuum, submitted. **Attachment 47**

criterion of the Examiner is met since the lower-energy hydrogen spectra was directly compared to ordinary hydrogen spectra.

Novel spectral lines were identified in Applicant's novel catalytic reaction comprising a helium-hydrogen plasma, wherein He^+ serves as the catalyst that reacts with atomic hydrogen to form hydrino (lower-energy hydrogen). The spectral lines can not be assigned to any known atom or molecule.[2] The spectral lines are shown to be an extension of the Rydberg series of lines to EUV wavelengths. The assignments to Rydberg's equation

$$E_n = -\frac{e^2}{n^2 8\pi\varepsilon_o a_H} = -\frac{13.598\ eV}{n^2} \text{ with } n = \frac{1}{p} = \frac{1}{\text{integer}}$$ are given in Table 1 of Mills[3].

Electronic transitions to these fractional Rydberg states catalyzed by the resonant nonradiative transfer of $m \cdot 27.2\ eV$ would give rise to a series of emission lines of energies $q \cdot 13.6\ eV$ where q is an integer. These lines were observed for the claimed catalytic reaction of He^+ with atomic hydrogen.

Specifically from Mills[4]: From a solution of a Schrodinger-type wave equation with a nonradiative boundary condition based on Maxwell's equations, Mills predicts that atomic hydrogen may undergo a catalytic reaction with certain atomized elements and ions which singly or multiply ionize at integer multiples of the potential energy of atomic hydrogen, $m \cdot 27.2\ eV$ wherein m is an integer. The reaction involves a nonradiative energy transfer to form a hydrogen atom that is lower in energy than unreacted atomic hydrogen that corresponds to a fractional principal quantum number $(n = \frac{1}{p} = \frac{1}{\text{integer}}$ replaces the well known

R. L. Mills, X. Chen, P. Ray, J. He, B. Dhandapani, "Plasma Power Source Based on a Catalytic Reaction of Atomic Hydrogen Measured by Water Bath Calorimetry", Thermochimica Acta, submitted. **Attachment 20**

[2] R. L. Mills, P. Ray, B. Dhandapani, J. He, "Extreme Ultraviolet Spectroscopy of Helium-Hydrogen Plasma", IEEE Transactions on Plasma Science, submitted. **Attachment 16**

R. L. Mills, P. Ray, B. Dhandapani, J. He, "Emission Spectroscopic Identification of Fractional Rydberg States of Atomic Hydrogen Formed by a Catalytic Helium-Hydrogen Plasma Reaction", Vacuum, submitted. **Attachment 47**

R. L. Mills, X. Chen, P. Ray, J. He, B. Dhandapani, "Plasma Power Source Based on a Catalytic Reaction of Atomic Hydrogen Measured by Water Bath Calorimetry", Thermochimica Acta, submitted. **Attachment 20**

[3] R. L. Mills, P. Ray, B. Dhandapani, J. He, "Energetic Helium-Hydrogen Plasma Reaction", AIAA Journal, submitted. **Attachment 10**

[4] R. L. Mills, P. Ray, B. Dhandapani, J. He, "Energetic Helium-Hydrogen Plasma Reaction", AIAA Journal, submitted. **Attachment 10**

parameter n = integer in the Rydberg equation for hydrogen excited states). One such atomic catalytic system involves helium ions. The second ionization energy of helium is $54.4 \ eV$; thus, the ionization reaction of He^+ to He^{2+} has a net enthalpy of reaction of $54.4 \ eV$ which is equivalent to $2 \cdot 27.2 \ eV$. Since the products of the catalysis reaction have binding energies of $m \cdot 27.2 \ eV$, they may further serve as catalysts. Extreme ultraviolet (EUV) spectroscopy was recorded on microwave and glow discharges of helium with 2% hydrogen. Novel emission lines were observed with energies of $q \cdot 13.6 \ eV$ where $q = 1,2,3,4,6,7,8,9,$ $or \ 11$ or these lines inelastically scattered by helium atoms wherein $21.2 \ eV$ was absorbed in the excitation of $He \ (1s^2)$ to $He \ (1s^1 2p^1)$. These lines were identified as hydrogen transitions to electronic energy levels below the "ground" state corresponding to fractional quantum numbers.

The reaction was very exothermic as measured by water bath calorimetry.[5] Extraordinary broadening of the atomic hydrogen lines was observed which also confirmed the novel high energetic catalytic reaction.[6]

Experimental Confirmation of Novel Lower-Energy Hydrogen Molecule

The novel lower-energy hydrogen molecule was identified by extreme ultraviolet (EUV) spectroscopy[7] and by condensation at liquid nitrogen

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[5] R. L. Mills, X. Chen, P. Ray, J. He, B. Dhandapani, "Plasma Power Source Based on a Catalytic Reaction of Atomic Hydrogen Measured by Water Bath Calorimetry", Thermochimica Acta, submitted. **Attachment 20**

[6] R. L. Mills, P. Ray, B. Dhandapani, R. M. Mayo, J. He, "Comparison of Excessive Balmer α Line Broadening of Glow Discharge and Microwave Hydrogen Plasmas with Certain Catalysts", J. of Applied Physics, (2002), Vol. 92, No. 12, pp. 7008-7022. **Attachment 46**

R. L. Mills, P. Ray, E. Dayalan, B. Dhandapani, J. He, "Comparison of Excessive Balmer α Line Broadening of Inductively and Capacitively Coupled RF, Microwave, and Glow Discharge Hydrogen Plasmas with Certain Catalysts", IEEE Transactions on Plasma Science, submitted. **Attachment 34**

[7] R. L. Mills, P. Ray, J. Dong, M. Nansteel, B. Dhandapani, J. He, "Spectral Emission of Fractional-Principal-Quantum-Energy-Level Atomic and Molecular Hydrogen", Vibrational Spectroscopy, in press. **Attachment 33**

R. L. Mills, P. Ray, J. Dong, M. Nansteel, B. Dhandapani, J. He, "Vibrational Spectral Emission of Fractional-Principal-Quantum-Energy-Level Molecular Hydrogen", Bulletin of the Chemical Society of Japan, submitted. **Attachment 4**

R. L. Mills, P. Ray, B. Dhandapani, X. Chen, "Comparison of Catalysts and Microwave Plasma Sources of Spectral Emission of Fractional-Principal-Quantum-Energy-Level Atomic and Molecular Hydrogen", Journal of Applied Spectroscopy, submitted. **Attachment 6**

R. L. Mills, P. Ray, B. Dhandapani, J. He, "Novel Liquid-Nitrogen-Condensable Molecular Hydrogen Gas", Polish Journal of Chemistry, submitted. **Attachment 8**

temperature.[8] The condensed gas was conclusively shown to be the dihydrino gas (lower-energy hydrogen gas) by the minimum liquefaction temperature of liquid nitrogen, optical emission spectroscopy on the hydrogen and deuterium forms, mass spectroscopy, ionization potential measurement, and nuclear magnetic resonance (NMR) spectroscopy. For example, from Mills[9]: Extreme ultraviolet (EUV) spectroscopy was recorded on microwave discharges of helium with 2% hydrogen. Novel emission lines were observed with energies of $q \cdot 13.6 \ eV$ where $q = 1,2,3,4,6,7,8,9,11$ or these discrete energies less $21.2 \ eV$ corresponding to inelastic scattering of these photons by helium atoms due to excitation of $He \ (1s^2)$ to $He \ (1s^1 2p^1)$. These lines matched $H(1/p)$, fractional Rydberg states of atomic hydrogen, formed by a resonant nonradiative energy transfer to He^+. Corresponding emission due to the reaction $2H(1/2) \rightarrow H_2(1/2)$ with vibronic coupling at $E_{D+vib} = p^2 E_{D \ H_2} \pm \left(\dfrac{\upsilon*}{3}\right) E_{vib \ H_2(\upsilon=0 \rightarrow \upsilon=1)}$, $\upsilon* = 1,2,3...$ was

observed at the longer wavelengths for $\upsilon* = 2$ to $\upsilon* = 32$ and at the shorter wavelengths for $\upsilon* = 1$ to $\upsilon* = 16$ where $E_{D \ H_2}$ and $E_{vib \ H_2(\upsilon=0 \rightarrow \upsilon=1)}$ are the experimental bond and vibrational energies of H_2, respectively. Fraction-principal-quantum-level molecular hydrogen $H_2(1/p)$ gas was isolated by liquefaction using an ultrahigh-vacuum liquid nitrogen cryotrap and was characterized by gas chromatography (GC), mass spectroscopy (MS), optical emission spectroscopy (OES), and ^1H NMR of the condensable gas dissolved in $CDCl_3$. The condensable gas was highly pure hydrogen by GC and MS and had a higher ionization energy than H_2. In addition to the Balmer series, a unique visible emission spectrum was observed by OES that shifted with deuterium substitution. An upfield shifted NMR peak was observed at 3.25 ppm compared to that of H_2 at 4.63 ppm.

R. L. Mills, P. Ray, B. Dhandapani, J. Dong, X. Chen, "Power Source Based on Helium-Plasma Catalysis of Atomic Hydrogen to Fractional Rydberg States", J. Mol. Struct., submitted. **Attachment 12**

[8] R. L. Mills, P. Ray, B. Dhandapani, J. He, "Novel Liquid-Nitrogen-Condensable Molecular Hydrogen Gas", Polish Journal of Chemistry, submitted. **Attachment 8**

[9] R. L. Mills, P. Ray, B. Dhandapani, J. He, "Novel Liquid-Nitrogen-Condensable Molecular Hydrogen Gas", Polish Journal of Chemistry, submitted. **Attachment 8**

The novel reaction was very exothermic as measured by water bath calorimetry.[10]

Experimental Confirmation of Novel Lower-Energy Hydrogen Molecular Ion

The novel lower-energy hydrogen molecular ion was identified by extreme ultraviolet (EUV) spectroscopy.[11] For example, from Mills[12]: Novel emission lines with energies of $q \cdot 13.6 \ eV$ where $q = 1,2,3,4,6,7,8,9,$ or 11 were previously observed by extreme ultraviolet (EUV) spectroscopy recorded on microwave discharges of helium with 2% hydrogen.[13] These lines matched $H(1/p)$, fractional Rydberg states of atomic hydrogen where p is an integer, formed by a resonant nonradiative energy transfer to He^+ acting as a catalyst. Ne^+ and Ar^+ also serve as catalysts to form $H(1/p)$; whereas, krypton, xenon, and their ions serve as controls. $H(1/p)$ may react with a proton to form a molecular ion $H_2(1/p)^+$ that has a bond energy and vibrational levels that are p^2 times those of the molecular ion comprising uncatalyzed atomic hydrogen. Extreme ultraviolet (EUV) spectroscopy was recorded on microwave, glow discharge, and RF plasmas of the noble gases mixed with 10% hydrogen in the range 10-65 nm. Emission in this region due to the reaction $H(1/4) + H^+ \rightarrow H_2(1/4)^+$ with vibronic

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[10] R. L. Mills, P. Ray, B. Dhandapani, J. Dong, X. Chen, "Power Source Based on Helium-Plasma Catalysis of Atomic Hydrogen to Fractional Rydberg States", J. Mol. Struct., submitted. **Attachment 12**

[11] R. Mills, J. He, B. Dhandapani, P. Ray, "Comparison of Catalysts and Microwave Plasma Sources of Vibrational Spectral Emission of Fractional-Rydberg-State Hydrogen Molecular Ion", Canadian Journal of Physics, submitted. **Attachment 3**
R. Mills, J. He, A. Echezuria, B Dhandapani, P. Ray, "Comparison of Catalysts and Microwave Plasma Sources of Vibrational Spectral Emission of Fractional-Rydberg-State Hydrogen Molecular Ion", Vibrational Spectroscopy, submitted. **Attachment 7**
R. Mills, J. He, A. Echezuria, B Dhandapani, P. Ray, "Comparison of Catalysts and Plasma Sources of Vibrational Spectral Emission of Fractional-Rydberg-State Hydrogen Molecular Ion", Vibrational Spectroscopy, submitted. **Attachment 13**
R. Mills, P. Ray, "Vibrational Spectral Emission of Fractional-Principal-Quantum-Energy-Level Hydrogen Molecular Ion", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 533-564. **Attachment 54**
R. L. Mills, P. Ray, B. Dhandapani, J. He, "Energetic Helium-Hydrogen Plasma Reaction", AIAA Journal, submitted. **Attachment 10**

[12] R. Mills, J. He, A. Echezuria, B Dhandapani, P. Ray, "Comparison of Catalysts and Plasma Sources of Vibrational Spectral Emission of Fractional-Rydberg-State Hydrogen Molecular Ion", Vibrational Spectroscopy, submitted. **Attachment 13**

[13] R. L. Mills, et. al., "New Power Source from Fractional Quantum Energy Levels of Atomic Hydrogen that Surpasses Internal Combustion", J Mol. Struct., Vol. 643, No. 1-3, (2002), pp. 43-54. **Attachment 50**

coupling at $E_{D+vib} = 4^2 E_{D\,H_2^+} \pm \upsilon *2^2 E_{vib\,H_2^+(\upsilon=0\to\upsilon=1)}$, $\upsilon* = 0,1,2,3...$ was observed at the longer wavelengths for $\upsilon* = 0$ to $\upsilon* = 20$ and at the shorter wavelengths for $\upsilon* = 0$ to $\upsilon* = 3$ where $E_{D\,H_2^+}$ and $E_{vib\,H_2^+(\upsilon=0\to\upsilon=1)}$ are the experimental bond and vibrational energies of H_2^+, respectively. The vibrational series was only observed for helium, neon, and argon with a microwave or glow discharge cell. The microwave cell consistently produced the most intense lines.

The novel catalytic reaction was observed to be very energetic as shown by Mills[14]: Extreme ultraviolet (EUV) spectroscopy was recorded on microwave discharges of helium with 2% hydrogen. Novel emission lines were observed with energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,11$ or these discrete energies less $21.2\ eV$ corresponding to inelastic scattering of these photons by helium atoms due to excitation of $He\,(1s^2)$ to $He\,(1s^1 2p^1)$. Additionally, novel extreme ultraviolet (EUV) vibrational-series emission lines with energies that empirically matched $E_{D+vib} = 4^2 E_{D\,H_2^+} \pm \upsilon *2^2 E_{vib\,H_2^+(\upsilon=0\to\upsilon=1)}$, $\upsilon* = 0,1,2,3...$ were observed from the helium-hydrogen plasma at the longer wavelengths for $\upsilon* = 0$ to $\upsilon* = 20$ and at the shorter wavelengths for $\upsilon* = 0$ to $\upsilon* = 3$ where $E_{D\,H_2^+}$ and $E_{vib\,H_2^+(\upsilon=0\to\upsilon=1)}$ are the experimental bond and vibrational energies of H_2^+, respectively. The average hydrogen atom temperature was measured to be $180\text{-}210\ eV$ versus $\approx 3\ eV$ for pure hydrogen. The electron temperature T_e for helium-hydrogen was $30,500 \pm 5\%\ K$ compared to $7400 \pm 5\%\ K$ for pure helium. Using water bath calorimetry, excess power was observed from the helium-hydrogen plasma compared to control krypton plasma. For example, for an input of 8.1 W, the total plasma power of the helium-hydrogen plasma measured by water bath calorimetry was 30.0 W corresponding to 21.9 W of excess power in 3 cm^3. The excess power density and energy balance were high, $7.3\ W/cm^3$ and $-2.9 \times 10^4\ kJ/mole\,H_2$, respectively. Known explanations for the two novel series of spectral lines, extraordinary broadening, and excess power were ruled out. These results can be explained as a catalytic reaction of atomic hydrogen to fractional Rydberg states. Dominant He^+ emission and an intensification of the plasma emission observed when He^+ was present with atomic hydrogen demonstrated the role of He^+ as a catalyst.

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[14] R. L. Mills, P. Ray, B. Dhandapani, J. He, "Energetic Helium-Hydrogen Plasma Reaction", AIAA Journal, submitted. **Attachment 10**

Experimental Confirmation of Novel Lower-Energy Hydride Ions

The novel lower-energy hydride ions were identified by high resolution visible spectroscopy, extreme ultraviolet (EUV) spectroscopy, time of flight secondary ion mass spectroscopy (ToF-SIMS), X-ray photoelectron spectroscopy (XPS), and nuclear magnetic resonance (NMR) spectroscopy.

$H^-(1/p)$ Nuclear Magnetic Resonance Shift

The following equations refer to those of Mills' book[15]:

The proton gyromagnetic ratio $\gamma_p / 2\pi$ is

$$\gamma_p / 2\pi = 42.57602 \, MHz \, T^{-1} \tag{7.59}$$

The NMR frequency f is the product of the proton gyromagnetic ratio given by Eq. (7.59) and the magnetic flux $\mathbf{B}$.

$$f = \gamma_p / 2\pi \mathbf{B} = 42.57602 \, MHz \, T^{-1} \mathbf{B} \tag{7.60}$$

The electrons of the compound of a sample influence the field at the nucleus such that it deviates slightly from the applied value. The corresponding chemical shift is proportional to the electronic magnetic flux change at the nucleus due to the applied field which in the case of each hydrino hydride ion is a function of its radius since all hydride ions $H^-(1/p)$ are isoelectronic. The change in the magnetic moment, $\Delta \mathbf{m}$, of each electron of the hydride ion of radius r due to an applied magnetic flux $\mathbf{B}$ is given by Purcell[16]

$$\Delta \mathbf{m} = -\frac{e^2 r^2 \mathbf{B}}{4 m_e} \tag{7.62}$$

The two electrons are spin-paired and the velocities are mirror opposites. Thus, the change in velocity of each electron treated individually (Eq. (10.3)) due to the applied field would be equal and opposite. However, the two paired electrons may be treated as one with twice the mass where m_e is replaced by $2m_e$ in Eq. (7.62). In this case, the paired electrons spin together about the applied field axis, the z-axis, to cause a reduction in the applied field according to Lenz' law. Then, the radius in Eq. (7.62) corresponds to the coordinate ρ in cylindrical coordinates since it is perpendicular to the direction of the applied field along the

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[15] R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2002 Edition, BlackLight Power, Inc., Cranbury, New Jersey, posted at www.blacklightpower.com.

[16] Purcell, E., Electricity and Magnetism, McGraw-Hill, New York, (1965), pp. 370-389.

z-axis. The integral over the entire flux linked by the hydride ion orbitsphere is given by

$$\Delta \mathbf{m} = -\frac{e^2 \mathbf{B}}{8m_e} \frac{\int_{-r_1}^{r_1}(r_1^2 - z^2)dz}{2r_1} = -\frac{2}{3}\frac{e^2 r_1^2 \mathbf{B}}{8m_e}$$ (7.63)

where r_1 is the radius of the hydride ion.[17] The change in magnetic flux $\Delta \mathbf{B}$ at the nucleus due to the change in magnetic moment, $\Delta \mathbf{m}$, given by Eq. (7.63) follows from Eq. (1.100).

$$\Delta \mathbf{B} = \mu_0 \frac{\Delta m}{r_1^3}(\mathbf{i}_r \cos\theta - \mathbf{i}_\theta \sin\theta) \qquad \text{for } r < r_n$$ (7.64)

where μ_0 is the permeability of vacuum. It follows from Eqs. (7.63-7.64) that the diamagnetic flux (flux opposite to the applied field) at the nucleus is inversely proportional to the radius. For resonance to occur, ΔH_0, the change in applied field from that given by Eq. (7.61), must compensate by an equal and opposite amount as the field due to the electrons of the hydrino hydride ion.

According to Eq. (7.57), the ratio of the radius of the hydrino hydride ion $H^-(1/p)$ to that of the hydride ion $H^-(1/1)$ is the reciprocal of an integer p. It follows from Eqs. (7.59-7.64) that compared to a proton with a no chemical shift, the ratio of ΔH_0 for resonance of the proton of the hydrino hydride ion $H^-(1/p)$ to that of the hydride ion $H^-(1/1)$ is a positive integer. That is, if only the radius is considered, the absorption peak of the hydrino hydride ion occurs at a valve of ΔH_0 that is a multiple of p times the value that is resonant for the hydride ion compared to that of a proton with no shift. However, a hydrino hydride ion is equivalent to the ordinary hydride ion except that it is in a lower energy state. The source current of the state must be considered in addition to the reduced radius.

As shown in the Stability of "Ground" and Hydrino States section, for the below "ground" (fractional quantum number) energy states of the hydrogen atom, σ_{photon}, the two-dimensional surface charge due to the "trapped photon" at the electron orbitsphere, is given by Eqs. (5.13) and (2.11).

$$\sigma_{photon} = \frac{e}{4\pi(r_n)^2}\left[Y_0^0(\theta,\phi) - \frac{1}{n}\left[Y_0^0(\theta,\phi) + \text{Re}\{Y_l^m(\theta,\phi)e^{i\omega_n t}\}\right]\right]\delta(r - r_n)$$

$$n = 1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, ...,$$ (7.65)

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[17]Fowles, G. R., Analytical Mechanics, Third Edition, Holt, Rinehart, and Winston, New York, (1977), p. 195-196.

And, $\sigma_{electron}$, the two-dimensional surface charge of the electron orbitsphere is

$$\sigma_{electron} = \frac{-e}{4\pi(r_n)^2}\left[Y_0^0(\theta,\phi) + \mathrm{Re}\{Y_\ell^m(\theta,\phi)e^{i\omega_n t}\}\right]\delta(r - r_n) \tag{7.66}$$

The superposition of σ_{photon} (Eq. (7.65)) and $\sigma_{electron}$, (Eq. (7.66)) where the spherical harmonic functions satisfy the conditions given in the Angular Function section is

$$\sigma_{photon} + \sigma_{electron} = \frac{-e}{4\pi(r_n)^2}\left[\frac{1}{n}Y_0^0(\theta,\phi) + \left(1 + \frac{1}{n}\right)\mathrm{Re}\{Y_\ell^m(\theta,\phi)e^{i\omega_n t}\}\right]\delta(r - r_n)$$

$$n = 1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, ..., \tag{7.67}$$

where $n = \frac{1}{p}$. The ratio of the charge density at the radius of the hydride ion of the hydrino hydride ion $H^-(1/p)$ to that of the hydride ion $H^-(1/1)$ is an integer p, and the source current of the hydrino hydride ion is equivalent to an integer p times that of an electron. Thus, it cancels the effect of the reduced radius. This is consistent with the $E_{electron\ 1final}(magnetic)$ term of Eq. (7.53).

The cancellation of the chemical shift due to the reduced radius by the source current is exact except for the relativistic effect given in the Spin-Orbital Coupling section. $\frac{e}{m_e}$ of the electron, the electron angular momentum of $\hbar$, and the electron magnetic momentum of μ_B are invariant for any electronic state. The same applies for the paired electrons of hydrino hydride ions. The condition that flux must be linked by the electron in units of the magnetic flux quantum in order to conserve the invariant electron angular momentum of $\hbar$ gives the additional chemical shift due to relativistic effects. Using Eqs. (2.84-2.85), Eq. (2.91) may be written as

$$E_{s/o} = \frac{\alpha\pi\mu_0 e^2\hbar^2}{m_e^2 r^3}\sqrt{\frac{3}{4}} = \alpha 2\pi 2\frac{e\hbar}{2m_e}\frac{\mu_0 e\hbar}{2m_e a_0^3}\sqrt{\frac{3}{4}} = \alpha 2\pi 2\mu_B B \tag{7.68}$$

From Eq. (7.68) and Eq. (1.194), the relativistic stored magnetic energy contributes a factor of $\alpha 2\pi$. The relativistic change in flux ΔB_{SR} may be calculated using Eq. (7.64) using the relativistic factor of $\alpha 2\pi$:

$$\Delta B_{SR} = -\alpha 2\pi\mu_0 \frac{\Delta m}{r_n^3}(i_r \cos\theta - i_\theta \sin\theta) \qquad \text{for } r < r_n \tag{7.69}$$

Thus, using Eqs. (7.57), (7.63), and (7.69), the upfield chemical shift $\frac{\Delta B_{SR}}{B}$ due to the relativistic effect of the ion $H^-(1/p)$ corresponding to the lower-energy state with principal quantum energy state p is given by

$$\frac{\Delta B_{SR}}{B} = -\alpha 2\pi\mu_0 \frac{pe^2}{12m_e a_0\left(1+\sqrt{s(s+1)}\right)} \tag{7.70}$$

The total shift $\frac{\Delta B_T}{B}$ for $H^-(1/p)$ is given by the sum of that of $H^-(1/1)$ given by

Eqs. (7.63) and (7.64) plus that given by Eq. (7.70):

$$\frac{\Delta B_T}{B} = -\mu_0 \frac{e^2}{12m_e a_0\left(1+\sqrt{s(s+1)}\right)}(1+\alpha 2\pi p) = -(29.9+1.37p)ppm \tag{7.71}$$

Alkali and alkaline earth hydrides and hydrino hydrides have been characterized by NMR[18] where the field was fixed and the NMR frequency was scanned. The experimental frequency of $H^-(1/1)$ compared to that of a proton and the upfield shifted peaks of $H^-(1/p)$ were consistent with Eq. (7.71). For example, ^1H MAS NMR was performed on novel hydrino hydride compound $KH*Cl$ synthesized with K as the catalyst, and the spectrum was compared to that of KH.[19] The ^1H MAS NMR spectrum of $KH*Cl$ relative to external tetramethylsilane (TMS) showed a resonance at 1.3 ppm that matched ordinary hydride ion. A large distinct upfield resonance at -4.4 identified a novel hydride ion of $KH*Cl$. (See attached Figure of the +300 to -300 ppm ^1H MAS NMR spectrum of $KH*Cl$ relative to external tetramethylsilane (TMS).) The experimental absolute resonance shift of TMS is -31.5 ppm relative to the proton's gyromagnetic frequency.[20] The KH experimental shift of +1.3 ppm relative to TMS corresponding to absolute resonance shift of -30.2 ppm matches very well the predicted shift of $H^-(1/1)$ of -30 ppm given by Eq. (7.71). The novel peak at -4.4 ppm relative to TMS corresponding to an absolute resonance

[18] R. Mills, B. Dhandapani, M. Nansteel, J. He, A. Voigt, "Identification of Compounds Containing Novel Hydride Ions by Nuclear Magnetic Resonance Spectroscopy", Int. J. Hydrogen Energy, Vol. 26, No. 9, (2001), pp. 965-979. **Attachment 64**

R. Mills, B. Dhandapani, M. Nansteel, J. He, T. Shannon, A. Echezuria, "Synthesis and Characterization of Novel Hydride Compounds", Int. J. of Hydrogen Energy, Vol. 26, No. 4, (2001), pp. 339-367. **Attachment 75**

R. Mills, B. Dhandapani, N. Greenig, J. He, "Synthesis and Characterization of Potassium Iodo Hydride", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1185-1203. **Attachment 73**

[19] R. Mills, B. Dhandapani, M. Nansteel, J. He, A. Voigt, "Identification of Compounds Containing Novel Hydride Ions by Nuclear Magnetic Resonance Spectroscopy", Int. J. Hydrogen Energy, Vol. 26, No. 9, (2001), pp. 965-979. **Attachment 64**

[20] K. K. Baldridge, J. S. Siegel, "Correlation of empirical δ(TMS) and absolute NMR chemical shifts predicted by ab initio computations", J. Phys. Chem. A, Vol. 103, (1999), pp. 4038-4042.

J. Mason, Editor, *Multinuclear NMR*, Plenum Press, New York, (1987), Chp. 3.

shift of -35.9 ppm indicates that p = 4 in Eq. (7.71). $H^-(1/4)$ is the hydride ion predicted by using K as the catalyst according to Eqs. (5.19-5.21). This assignment was further supported by the XPS spectrum of $KH*I$ that was also synthesized by using K as the catalyst. It differed from that of KI by having additional features at 9.1 eV and 11.1 eV.[21] The XPS peaks centered at 9.0 eV and 11.1 eV that do not correspond to any other primary element peaks corresponded to the $H^-(n=1/4)E_b = 11.2 \; eV$ hydride ion (Eq. (7.58)) in two different chemical environments where E_b is the predicted vacuum binding energy.

Extreme ultraviolet spectroscopy was performed on the potassium catalysis reaction.[22] Intense extreme ultraviolet (EUV) emission was observed from incandescently heated atomic hydrogen and the atomized potassium catalyst that generated an anomalous plasma at low temperatures (e.g. $\approx 10^3 \; K$) and an extraordinary low field strength of about 1-2 V/cm. No emission was observed with potassium or hydrogen alone or when sodium replaced potassium with hydrogen. Emission was observed from K^{3+} that confirmed the resonant nonradiative energy transfer of $3 \cdot 27.2 \; eV$ from atomic hydrogen to atomic potassium. The catalysis product, a lower-energy hydrogen atom, was predicted to be a highly reactive intermediate which further reacts to form a novel hydride ion. The predicted hydride ion of hydrogen catalysis by atomic potassium is the hydride ion $H^-(1/4)$. This ion was observed spectroscopically at 110 nm corresponding to its predicted binding energy of 11.2 eV.

HYDRINO HYDRIDE ION HYPERFINE LINES

For ordinary hydride ion H^-, a continuum is observed at shorter wavelengths of the ionization or binding energy referred to as the bound-free continuum. For typical conditions in the photosphere, Figure 4.5 of Stix[23] shows the continuous absorption coefficient $\kappa_c(\lambda)$ of the Sun. In the visible and infrared, the hydride ion H^- is the dominant absorber. Its free-free continuum

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[21] R. Mills, B. Dhandapani, N. Greenig, J. He, "Synthesis and Characterization of Potassium Iodo Hydride", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1185-1203. **Attachment 73**

[22] R. Mills, P. Ray, "Spectroscopic Identification of a Novel Catalytic Reaction of Potassium and Atomic Hydrogen and the Hydride Ion Product", Int. J. Hydrogen Energy, Vol. 27, No. 2, (2002), pp. 183-192. **Attachment 56**

[23] M. Stix, The Sun, Springer-Verlag, Berlin, (1991), p. 136.

starts at $\lambda = 1.645\ \mu m$, corresponding to the ionization energy of $0.745\ eV$ for H^- with strongly increasing absorption towards the far infrared. The ordinary hydride spectrum recorded on the Sun is representative of the hydride spectrum in a very hot plasma.

Hydride ions formed by the reaction of hydrogen or hydrino atoms (lower-energy hydrogen atoms) with free electrons with a kinetic energy distribution give rise to the bound-free emission band to shorter wavelengths than the ionization or binding energy due to the release of the electron kinetic energy and the hydride ion binding energy. As shown by Eq. (7.55), the energies for the formation of hydrino hydride ions are much greater, and with sufficient spectroscopic resolution, it may be possible to resolve hyperfine structure in the corresponding bound-free band due to interactions of the free and bound electrons. The derivation of the hyperfine lines follows.

Consider a free electron binding to a hydrino atom to form a hydrino hydride ion. The total angular momentum of an electron is $\hbar$. During binding of the free electron, the bound electron produces a magnetic field at the free electron given by Eq. (1.101). Thus, for radial distances greater than the radius of the hydride ion, the magnetic field is equivalent to that of a magnetic dipole of a Bohr magneton at the origin. The energy of interaction of a magnetic dipole with the magnetic field of the bound electron E_{ss}, the spin-spin energy, is given by Eq. (1.195)—the product of the electron g factor given by Eq. (1.194), the magnetic moment of the free electron, a Bohr magneton given by Eq. (1.99), and the magnetic flux which follows from Eq. (1.101).

$$E_{ss} = g\mu_B\mu_0 H = g\mu_B B = g\frac{\mu_0}{r^3}\left(\frac{e\hbar}{2m_e}\right)^2 \tag{7.72}$$

where μ_0 is the permeability of free space, r is the radius of hydride ion $H^-(n=1/p)$ given by Eq. (7.56), and p is an integer. E_{ss} for $H^-(1/2)$ is given by

$$E_{ss} = 0.011223\ eV \tag{7.73}$$

where the radius given by Eq. (7.56) is

$$r_1 = 0.93301a_0 \tag{7.74}$$

where $p = 2$. From Eqs. (7.55) and (7.56), the binding energy E_B of $H^-(1/2)$ is

$$E_B = 3.0471\ eV\ (4069.0\ \text{Å}) \tag{7.75}$$

When a free electron binds to the hydrino atom $H(1/2)$ to form a hydride ion $H^-(1/2)$, a photon is emitted with a minimum energy equal to the binding energy ($E_B = 3.0471\ eV$). Any kinetic energy that the free electron possess must

increase the energy of the emitted photon. The interaction of the two electrons quantizes this emission by the same mechanism as that observed in the Stern Gerlach experiment—quantization of flux linkage. Superconducting Quantum Interference Devices (SQUIDs) or wire loops linked to SQUIDs also show quantization of flux and the corresponding energies as shown in the Schrödinger Fat Cats—Another Flawed Interpretation section.

In the Stern-Gerlach experiment, a magnetic field is applied along the z-axis called the spin axis. S, the projection of the angular momentum of an electron onto an axis which precesses about the z-axis, is $\pm\sqrt{\frac{3}{4}}\hbar$. S rotates about the z-axis at the Larmor frequency, and $\langle S_z \rangle$, the time averaged projection of the electron angular momentum onto the axis of the applied magnetic field is $\pm\frac{\hbar}{2}$ as shown in the Spin Angular Momentum of the Orbitsphere with $\ell = 0$ section. As given in the Electron g Factor section, the electron links flux in units of the magnetic flux quantum $\Phi_0 = \frac{h}{2e}$ during a Stern-Gerlach transition which conserves the angular momentum of the electron of $\hbar$. Due to the field of the bound electron, the free electron possessing kinetic energy will precess with a precessional angular momentum as well as an intrinsic angular momentum of $\pm\sqrt{s(s+1)}\hbar = \pm\sqrt{\frac{3}{4}}\hbar$. In order to conserve angular momentum of both electrons as the bound electron links an integer number of fluxons due to the free electron, the total angular momentum of the free electron must have a magnitude that is an integer number of $\frac{\hbar}{\sqrt{s(s+1)}}$. The corresponding fluxon energy E_Φ follows from Eq. (1.194) wherein the angular momentum corresponding to the Bohr magneton, $\hbar$, is replaced by $j\frac{\hbar}{\sqrt{s(s+1)}}$, and the magnetic flux density B is given by the ratio of the flux to the area.

$$E_\Phi = j(g-2)\frac{\mu_B}{\sqrt{s(s+1)}}B = j(g-2)\frac{\mu_B}{\sqrt{s(s+1)}}\left(\frac{j\Phi_o}{A}\right) = j^2(g-2)\frac{\mu_B}{\sqrt{s(s+1)}}B$$

$$= j^2(g-2)\frac{\mu_B}{\sqrt{s(s+1)}}\frac{\mu_0}{r^3}\left(\frac{e\hbar}{2m_e}\right)$$

(7.76)

where j is an integer, $s = 1/2$, and A is the area linked by the integer number of fluxons as given in the Electron g Factor section. The flux linkage energy applies to each of the two electrons; thus, a factor of two in Eq. (7.76) is required. This is

analogous to mutual induction. The electrons flip in opposite directions and conserve angular momentum by linking flux in integer units of the magnetic flux quantum which corresponds to the term $(g-2)$. With the radius given by Eq. (7.74), the fluxon energy E_Φ of $H^-(1/2)$ for both electrons is given by

$$E_\Phi = j^2 2(g-2)\frac{\mu_B}{\sqrt{s(s+1)}}\frac{\mu_0}{r^3}\left(\frac{e\hbar}{2m_e}\right) = j^2 3.00213 \times 10^{-5} \ eV \tag{7.77}$$

The energies of the hyperfine lines E_{HF}, are given by the sum of the binding energy (Eqs. (7.55) and (7.75)), the spin-spin energy (Eqs. (7.72) and (7.73)), and the fluxon energy (Eqs. (7.76) and (7.77)).

$$E_{HF} = E_\Phi + E_{ss} + E_B = j^2 3.00213 \times 10^{-5} + 0.011223 + 3.0471 \ eV$$

$$(j \text{ is an integer}) \tag{7.78}$$

$$= j^2 3.00213 \times 10^{-5} + 3.0583 \ eV$$

The observation of bound-free hyperfine peaks requires an electron binding threshold with a large cross section. Ordinary hydride ion does not have a fine structure transition; thus, it shows only a hydride binding energy continuum.[24] The existence of fine structure transitions in $H(1/2)$ provides a mechanism to observe a peak corresponding to the formation of a free hydride ion by the binding of an electron. The predicted energy difference between the $1/2P_{1/2}$, $1/2S_{1/2}$ and $1/2P_{3/2}$ levels of the hydrogen atom, the fine structure splitting given by Eq. (2.91), is

$$E_{s/o} = 8\alpha^5(2\pi)^2 m_e c^2 \sqrt{\frac{3}{4}} = 2.8922 \times 10^{-3} \ eV \tag{7.79}$$

The peak due to the binding energy (Eq. (7.75)) with excitation the fine structure splitting (Eq. (7.79)) is given by

$$E_{s/o} = E_B - E_{s/o} = 3.0471 \ eV - 2.8922 \times 10^{-3} \ eV = 3.0442 \ eV \ (\lambda_{air} = 4071.7 \ \text{Å}) \tag{7.80}$$

The $1/2P_{3/2}$, $1/2P_{1/2}$, and $1/2S_{1/2}$ levels are also split by spin-nuclear and orbital-nuclear coupling. $1/2S_{1/2}$—$1/2P_{3/2}$ and $1/2P_{1/2}$—$1/2P_{3/2}$ transitions occur between hyperfine levels; thus, the transition energy is the sum of the fine structure and the corresponding hyperfine energy. The hyperfine splittings of $H(1/2)$ given in the SPIN-NUCLEAR COUPLING section are $1.197 \times 10^{-4} \ eV$ and $3.153 \times 10^{-4} \ eV$ for $\ell = 0$ and $\ell = 1$, respectively. In addition to a continuum, the binding of an electron to $H(1/2)$ has a resonance emission with excitation of transitions between hyperfine levels of the fine structure levels.

[24] K. R. Lykke, K. K. Murray, W. C. Lineberger, "Threshold photodetachment of H^-", Phys. Rev. A, Vol. 43, No. 11, (1991), pp. 6104-6107.

The catalyst product of Rb^+ and two K^+, $H(1/2)$, was predicted to be a highly reactive intermediate which further reacts to form a novel hydride ion $H^-(1/2)$. This hydride ion with a predicted binding energy of 3.0471 eV was observed by high resolution visible spectroscopy as a continuum threshold at 3.047 eV (λ_{air} = 4068 Å), and a structured, strong emission peak was observed at 4071 Å corresponding to the fine structure and hyperfine structure of $H(1/2)$.[25] The experimental $H^-(1/2)$ peak at 4070.6 Å (air wavelength) was used to calculate the peak positions of the bound-free hyperfine lines. Substitution of the corresponding energy of 3.0451 eV into Eq. (7.78) for E_B gives

$$E_{HF} = E_\Phi + E_{ss} + E_B = j^2 3.00213 \, X \, 10^{-5} + 0.011223 + 3.0451 \ eV$$

<div align="right">(j is an integer)   (7.81)</div>

$$= j^2 3.00213 \, X \, 10^{-5} + 3.0563 \ eV$$

Bound-free hyperfine structure lines of $H^-(1/2)$ were predicted with energies E_{HF} given by Eq. (7.81) as an inverse Rydberg-type series from 3.0563 eV to 3.1012 eV—the hydride binding energy peak plus one and five times the spin-pairing energy, respectively. The high resolution visible plasma emission spectra in the region of 3995 Å to 4060 Å matched the predicted emission lines for $j = 1$ to $j = 39$ with the series edge at 3996.3 Å up to 1 part in 10^5.[26] The structure of these peaks matched that of $H^-(1/2)$ which corresponded to the predicted hyperfine splitting. All species present in the reaction or possible contaminants were eliminated as the source of the 4071 Å peak, the series of 39 lines, and series the edge. In particular, nitrogen, air, and hydrogen were eliminated.

The high resolution visible spectroscopy results were supported by the NMR of the reaction product. A novel peak at -2.5 ppm relative to TMS corresponding to an absolute resonance shift of -34.0 ppm indicates that p = 2 in Eq. (7.71).[27] $H^-(1/2)$ is the hydride ion predicted by using K^+ / K^+ as the catalyst

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[25] R. L. Mills, P. Ray, "A Comprehensive Study of Spectra of the Bound-Free Hyperfine Levels of Novel Hydride Ion $H^-(1/2)$, Hydrogen, Nitrogen, and Air", Int. J. Hydrogen Energy, in press. **Attachment 41**

[26] R. L. Mills, P. Ray, "A Comprehensive Study of Spectra of the Bound-Free Hyperfine Levels of Novel Hydride Ion $H^-(1/2)$, Hydrogen, Nitrogen, and Air", Int. J. Hydrogen Energy, in press. **Attachment 41**

[27] R. Mills, B. Dhandapani, N. Greenig, J. He, "Synthesis and Characterization of Potassium Iodo Hydride", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1185-1203. **Attachment 73**

according to Eqs. (5.28-5.30). In addition to spectroscopy on the $H^-(1/2)$ hydride ion product, the energetic reaction of K^+/K^+ catalyst with atomic hydrogen has been characterized. Each of the ionization of Rb^+ and cesium and an electron transfer between two K^+ ions (K^+/K^+) provide a reaction with a net enthalpy of an integer multiple of the potential energy of atomic hydrogen, $27.2\ eV$. The corresponding Group I nitrates provide these reactants as volatilized ions directly or as atoms by undergoing decomposition or reduction to the corresponding metal. The presence of each of the reactants identified as providing an enthalpy of $27.2\ eV$ formed a low applied temperature, extremely low voltage plasma in atomic hydrogen called a resonant transfer or rt-plasma having strong vacuum ultraviolet (VUV) emission. In contrast, magnesium and aluminum atoms or ions do not ionize at integer multiples of the potential energy of atomic hydrogen. $Mg(NO_3)_2$ or $Al(NO_3)_3$ did not form a plasma and caused no emission.[28] Anomalous afterglow durations of plasmas formed by catalysts providing a net enthalpy of reaction within thermal energies of $m \cdot 27.28\ eV$ including hydrogen-potassium mixtures were observed.[29] Emission from rt-plasmas occurred even when the electric field applied to the plasma was zero.

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[28] R. L. Mills, P. Ray, "A Comprehensive Study of Spectra of the Bound-Free Hyperfine Levels of Novel Hydride Ion $H^-(1/2)$, Hydrogen, Nitrogen, and Air", Int. J. Hydrogen Energy, in press. **Attachment 41**

R. Mills, P. Ray, R. M. Mayo, "CW HI Laser Based on a Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Group I Catalysts", IEEE Transactions on Plasma Science, in press. **Attachment 32**

H. Conrads, R. Mills, Th. Wrubel, "Emission in the Deep Vacuum Ultraviolet from a Plasma Formed by Incandescently Heating Hydrogen Gas with Trace Amounts of Potassium Carbonate", Plasma Sources Science and Technology, submitted. **Attachment 36**

R. Mills, "Temporal Behavior of Light-Emission in the Visible Spectral Range from a Ti-K2CO3-H-Cell", Int. J. Hydrogen Energy, Vol. 26, No. 4, (2001), pp. 327-332. **Attachment 70**

R. Mills, T. Onuma, and Y. Lu, "Formation of a Hydrogen Plasma from an Incandescently Heated Hydrogen-Catalyst Gas Mixture with an Anomalous Afterglow Duration", Int. J. Hydrogen Energy, Vol. 26, No. 7, July, (2001), pp. 749-762. **Attachment 71**

[29] H. Conrads, R. Mills, Th. Wrubel, "Emission in the Deep Vacuum Ultraviolet from a Plasma Formed by Incandescently Heating Hydrogen Gas with Trace Amounts of Potassium Carbonate", Plasma Sources Science and Technology, submitted. **Attachment 36**

R. Mills, "Temporal Behavior of Light-Emission in the Visible Spectral Range from a Ti-K2CO3-H-Cell", Int. J. Hydrogen Energy, Vol. 26, No. 4, (2001), pp. 327-332. **Attachment 70**

R. Mills, T. Onuma, and Y. Lu, "Formation of a Hydrogen Plasma from an Incandescently Heated Hydrogen-Catalyst Gas Mixture with an Anomalous Afterglow Duration", Int. J. Hydrogen Energy, Vol. 26, No. 7, July, (2001), pp. 749-762. **Attachment 71**

For further characterization, the width of the 6563 Å Balmer α line on light emitted from rt-plasmas was recorded. Significant line broadening of 18, 12, *and* 12 eV was observed from a rt-plasma of hydrogen with KNO_3, $RbNO_3$, and $CsNO_3$, respectively, compared to 3 eV from a hydrogen microwave plasma. These results could not be explained by Stark or thermal broadening or electric field acceleration of charged species since the measured field of the incandescent heater was extremely weak, 1 V/cm, corresponding to a broadening of much less than 1 eV. Rather the source of the excessive line broadening is consistent with that of the observed VUV emission, an energetic reaction caused by a resonant energy transfer between hydrogen atoms and K^+ / K^+, Rb^+, and cesium, which serve as catalysts.

KNO_3 and $RbNO_3$ formed the most intense plasma. Remarkably, a stationary inverted Lyman population was observed in the case of an rt-plasma formed with potassium and rubidium catalysts. These catalytic reactions may pump a cw H I laser as predicted by a collisional radiative model used to determined that the observed overpopulation was above threshold.[30] The reaction catalytic reaction was measured to be exothermic with a large energy balance.[31]

The catalytic reaction of atomic hydrogen with K^+ / K^+ to form novel hydride ions was also confirmed by the isolation of novel inorganic hydride compounds such as $KHKHCO_3$ and KH following each of the electrolysis and plasma electrolysis of a K_2CO_3 electrolyte which comprised high binding energy hydride ions that were stable in water with their identification by methods such as (i) ToF-SIMS on $KHKHCO_3$ which showed inorganic hydride clusters $K[KHKHCO_3]_n^+$ and a negative ToF-SIMS dominated by hydride ion, (ii) X-ray photoelectron spectroscopy which showed novel peaks corresponding to high binding energy hydride ions, and (iii) proton nuclear magnetic resonance

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[30] R. Mills, P. Ray, R. M. Mayo, "CW HI Laser Based on a Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Group I Catalysts", IEEE Transactions on Plasma Science, in press. **Attachment 32**

[31] R. Mills, P. C. Ray, R. M. Mayo, M. Nansteel, W. Good, P. Jansson, B. Dhandapani, J. He, "Stationary Inverted Lyman Populations and Free-Free and Bound-Free Emission of Lower-Energy State Hydride Ion Formed by an Exothermic Catalytic Reaction of Atomic Hydrogen and Certain Group I Catalysts", Physical Chemistry Chemical Physics, submitted. **Attachment 44**

spectroscopy which showed upfield shifted peaks corresponding to more diamagnetic, high-binding-energy hydride ions.[32]

The lower-energy hydride ions (hydrino hydride ions) were identified as a product from the claimed catalytic reaction of atomic hydrogen and He^+ catalyst to form hydrinos which reacted to form the hydrino hydride ions. For example as shown in Mills[33], a novel highly stable surface coating $SiH(1/p)$ which comprised high binding energy hydride ions was synthesized by a microwave plasma reaction of a mixture of silane, hydrogen, and helium wherein it is proposed that He^+ served as a catalyst with atomic hydrogen to form the highly stable hydride ions. Novel silicon hydride was identified by time of flight secondary ion mass spectroscopy and X-ray photoelectron spectroscopy. The time of flight secondary ion mass spectroscopy (ToF-SIMS) identified the coatings as hydride by the large SiH^+ peak in the positive spectrum and the dominant H^- in the negative spectrum. X-ray photoelectron spectroscopy (XPS) identified the H content of the SiH coatings as hydride ions, $H^-(1/4)$, $H^-(1/9)$, and $H^-(1/11)$ corresponding to peaks at 11, 43, and 55 eV, respectively. The silicon hydride surface was remarkably stable to air as shown by XPS. The highly stable amorphous silicon hydride coating may advance the production of integrated circuits and microdevices by resisting the oxygen passivation of the surface and possibly altering the dielectric constant and band gap to increase device performance.

The plasma which formed $SiH(1/p)$ showed a number of extraordinary features. Novel emission lines with energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,\ or\ 11$ were previously observed by extreme ultraviolet (EUV) spectroscopy recorded on microwave discharges of helium with 2% hydrogen.[34]

[32] R. Mills, E. Dayalan, P. Ray, B. Dhandapani, J. He, "Highly Stable Novel Inorganic Hydrides from Aqueous Electrolysis and Plasma Electrolysis", Electrochimica Acta, Vol. 47, No. 24, (2002), pp. 3909-3926. **Attachment 45**

R. Mills, "Novel Inorganic Hydride", Int. J. of Hydrogen Energy, Vol. 25, (2000), pp. 669-683. **Attachment 74**

R. Mills, "Highly Stable Novel Inorganic Hydrides", Journal of New Materials for Electrochemical Systems, in press. **Attachment 76**

[33] R. L. Mills, J. He, P. Ray, B. Dhandapani, X. Chen, "Synthesis and Characterization of a Highly Stable Amorphous Silicon Hydride as the Product of a Catalytic Helium-Hydrogen Plasma Reaction", Int. J. Hydrogen Energy, in press. **Attachment 38**

[34] R. Mills, P. Ray, "Spectral Emission of Fractional Quantum Energy Levels of Atomic Hydrogen from a Helium-Hydrogen Plasma and the Implications for Dark Matter", Int. J. Hydrogen Energy, Vol. 27, No. 3, pp. 301-322. **Attachment 55**

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These lines matched $H(1/p)$, fractional Rydberg states of atomic hydrogen where p is an integer, formed by a resonant nonradiative energy transfer to He^+ acting as a catalyst. The average hydrogen atom temperature of the helium-hydrogen plasma was measured to be $180 - 210 \ eV$ versus $\approx 3 \ eV$ for pure hydrogen. Using water bath calorimetry, excess power was observed from the helium-hydrogen plasma compared to control krypton plasma. For example, for an input of 8.1 W, the total plasma power of the helium-hydrogen plasma measured by water bath calorimetry was 30.0 W corresponding to 21.9 W of excess power in 3 cm^3. The excess power density and energy balance were high, $7.3 \ W/cm^3$ and $-2.9 \times 10^4 \ kJ/mole \ H_2$, respectively. This catalytic plasma reaction represents a new hydrogen energy source and a new field of hydrogen chemistry.

In view of the foregoing discussion, Applicant kindly requests that the Examiner reconsider his position, which "found the compelling experimental evidence to be inconclusive as presented." [Final Office Action at p. 2] To the contrary, Applicant's compelling experimental evidence demonstrating the existence of novel hydrogen species is conclusive as presented. Based on that evidence, Applicant has overcome the final rejections of record and the claims are in condition for allowance.

The Rejection Under 35 U.S.C. § 101 is Improper and Should be Withdrawn

The rejection of claims 1-209 under 35 U.S.C. § 101 is respectfully traversed for the reasons stated above explaining the Examiner's failure to properly consider and analyze the totality of Applicant's experimental evidence confirming the existence of lower-energy hydrogen.

That rejection is also untenable for all the reasons explained in Applicant's previous Response to the Examiner's first Office Action. Once again, the Examiner does not rebut, or otherwise address, the points raised in that prior Response. Rather, the Examiner simply repeats the same rejections by stating on page 3 of the Final Office Action that "[t]he rejections as stated in the previous Office Action (Paper #6) dated July 13, 2001 are applicable to claims 1-10, as well as to the new claims 11-209 . . . . "

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Regarding the rejection of claims under Section 101, Applicant's Response to the first Office Action explained how that rejection is improperly based on the false premise that Applicant's lower-energy hydrogen technology is "not supported by a credible asserted utility or a well established utility," and, therefore, should be withdrawn. In continuing to promote that Section 101 rejection, the Examiner still fails to follow the appropriate legal standards that govern the evaluation of utility, creating new standards in the process.

The Examiner begins his Section 101 evaluation of Applicant's assertion of utility by concluding at the outset that it's not credible, without evaluating the evidentiary basis for that assertion. In doing so, the Examiner misapplies the standards under Section 101, as outlined in MPEP § 2107.01, p. 2100-31:

> [The Examiner] should not begin an evaluation of utility by assuming that an asserted utility is likely to be false, based on the technical field of the invention or for other general reasons.
> * * *
> 'Incredible utility' is a conclusion, not a starting point for analysis under 35 U.S.C. § 101. A conclusion that an asserted utility is incredible can be reached only after the Office has evaluated both the assertion of the applicant regarding utility and any evidentiary basis of that assertion. The [Examiner] should be particularly careful not to start with a presumption that an asserted utility is, per se, "incredible" and then proceed to base a rejection under 35 U.S.C. 101 on that presumption. [Double emphasis added.]

In applying the present Section 101 rejection, the Examiner ignores this mandate and improperly presumes the utility of Applicant's invention to be per se incredible, while ignoring the vast majority of theoretical explanation and experimental evidence supporting that utility. For instance, the Examiner has not yet provided any explanation of how the extensive theory disclosed in the present specification is in error and why the supporting experimental evidence does not demonstrate the utility of what Applicant is claiming. Instead, the Examiner continues to violate Section 101 standards by merely concluding that "[t]he invention is based upon assumptions that are contrary to basic, well established, laws of quantum physics and, therefore, is inoperative and lacks utility." [Final Office Action at p. 4]

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To make matters worse, the Examiner does not even bother to explain what "laws" Applicant's invention supposedly contradicts. Indeed, Applicant's invention, as described in the specification, is based upon first principles or laws of physics, including Maxwell's Equations.

This failure to follow the Patent Office's own procedures as outlined in MPEP § 2107.01 alone mandates that the Section 101 rejection be withdrawn.

The Examiner's Section 101 rejection further violates the established practice courts have laid out for evaluating utility, as summarized in MPEP § 2107.01:

> As a matter of Patent Office practice, a specification which contains a disclosure of utility which corresponds in scope to the subject matter sought to be patented <u>must</u> be taken as sufficient to satisfy the utility requirement of § 101 for the entire claimed subject matter <u>unless</u> there is a reason for one skilled in the art to question the objective truth of the statement of utility or its scope. *In re Langer*, 183 USPQ 288, 297 (CCPA 1974) [Emphasis added.]

Thus, the Patent Office must have adequate support for its challenge to the credibility of Applicant's assertions of utility. Only then does the burden 0shift to Applicant to provide rebuttal evidence. *In re Bundy*, 209 USPQ 48, 51 (CCPA 1981). Because the Examiner has still failed to properly consider all of Applicant's disclosure and supporting experimental evidence in rejecting claims under Section 101, his conclusions of incredibility are completely unfounded and the burden has not yet shifted to Applicant.

To meet the initial burden of showing a lack of utility, it is not enough for the Examiner to simply state, as she does repeatedly throughout the Final Office Action, that Applicant's invention employs novel hydrogen species and compositions of matter comprising new forms of hydrogen having lower energy states, "which, up to now, have not been shown to exist." By definition, something that is novel has never been shown to exist. To require that Applicant show that his invention is not novel, i.e., anticipated—and, therefore, unpatentable—before he can demonstrate utility makes no sense whatsoever.

For these reasons alone, the Section 101 rejection should be withdrawn.

Even if the burden to demonstrate the utility of the claimed invention has shifted to Applicant, he has provided more than sufficient disclosure of his theory and supporting evidence to meet that burden, as explained in his present and prior Responses. The evidentiary standard to be used throughout the prosecution is a preponderance of the totality of the evidence with due consideration to persuasiveness of the arguments. *In re Oetiker*, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992). MPEP § 2107.01 sets forth the procedures for applying this standard:

> Office personnel must provide evidence sufficient to show that the statement of asserted utility would be considered "false" by a person of ordinary skill in the art. Of course, a person of ordinary skill must have the benefit of both facts and reasoning in order to assess the truth of a statement. This means that if applicant has presented facts that support the reasoning used in asserting a utility, Office personnel must present countervailing facts and reasoning sufficient to establish that a person of ordinary skill would not believe the applicant's assertion of utility. *In re Brana*, 51 F.3d 1560, 34 USPQ2d 1436 (Fed. Cir. 1995). The initial evidentiary standard used during evaluation of this question is a preponderance of the evidence (i.e., the totality of the facts and reasoning suggest that it is more likely than not that the statement of the applicant is false). [Emphasis added.]

The Examiner has yet to provide any countervailing facts and credible reasoning that the claimed invention lacks utility. Rather, the Examiner continues to provide mere conclusory statements referring to "well established laws" of "contemporary quantum physics" that are supposedly contradicted by the existence of Applicant's lower-energy hydrogen without indentifying which such laws have been violated. That is not surprising considering that contempary quantum physics is based wholly on theory, not laws, which theory has been shown to be seriously flawed. [See Attachment C]

Incredibly, the Examiner goes even further by claiming on page 5 of the Final Office Action that such lower-energy states of hydrogen are not even possible:

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A hydrogen atom with its electron in a lower then "ground state" energy level corresponds to a fractional quantum number (defined in the invention as a hydrino) <u>which, up to now, is not possible by contemporary quatum physics</u>.   (Emphasis added.)

The Examiner, however, has not provided even one shred of evidence demonstrating why lower-energy states of hydrogen are not possible.   Applicant, on the other hand, has submitted a vast body of experimental evidence demonstrating that the formation of lower-energy hydrogen is not only a possibility, but a reality.   As explained above, the Examiner's failure to properly consider that evidence renders the rejection under Section 101 fatally defective.

In an effort to evoke what hopefully will be a positive response from the Examiner to the previously submitted experimental evidence of record, Applicant presents it once more for consideration and analysis as an Attachment to this Response. [Attachment A] In the event, however, that the Examiner is still not persuaded, Applicant respectfully requests that she provide specific reasoning and analysis for his views.

It is clear from these presentations and papers that Applicant's lower-energy hydrogen technology has been openly discussed and has credibility with the scientific community.   This significant body of real-world experimental evidence conclusively confirms the formation of lower-energy hydrogen and, by extension, the utility of Applicant's claimed invention based on that technology.

Applicant appreciates the fact that the Examiner has, at least, begun to touch on some of that real-world evidence, i.e. spectroscopic data, with her comments that:

> [T]he demonstration of the existence of a novel hydrogen species having lower energy state is best demonstrated by a shift in the Lyman series lines toward the far ultra-violet. This data should be compared to the regular hydrogen series. [Final Office Action at p. 2]

Considering such evidence to determine whether novel hydrogen species exists is the only way to resolve the theoretical debate that has erupted over competing quantum theories. Given, however, the Examiner's failure to fully

evaluate and critique the complete body of evidence of record in this case, it stands as unrebutted and, thus, easily overcomes the rejections of pending claims 1-209 under 35 U.S.C. § 101.

Accordingly, withdrawal of the Section 101 rejection is respectfully requested.

The Rejection Under 35 U.S.C. § 112-1 is Improper and Should be Withdrawn

The rejection of claims 1-209 under 35 U.S.C. § 112-1 is respectfully traversed as the Examiner has once again failed to follow the appropriate legal standards of enablement by ignoring the vast body of experimental evidence of record confirming the existence of lower-energy hydrogen.

In making that rejection, the Examiner simply argues:

> Specifically, since the claimed invention is not supported by either a credible asserted utility or a well established utility for the reasons set forth above [regarding the Section 101 rejection], one skilled in the art clearly would not know how to use the claimed invention.
> [Final Office Action at p. 6]

That argument is fatally flawed for two reasons. First, as discussed above, Applicant has shown that his invention meets the utility requirements of Section 101. Therefore, one skilled in the art would know how to use the claimed invention and the Examiner's rejection fails. Second, the Examiner has failed to make a *prima facie* case of non-enablement in accordance with accepted legal standards governing Section 112-1.

MPEP § 2164.05 summarize those standards as follows:

> Once the examiner has weighed all the evidence and established a reasonable basis to question the enablement provided for the claimed invention, the burden falls on applicant to present persuasive arguments, supported by suitable proofs where necessary, that one skilled in the art would be able to make and use the claimed invention using the application as a guide. In re Brandstadter, 484 F.2d 1395, 1406-07, 179 USPQ 286, 294 (CCPA 1973). The evidence provided by applicant need not be conclusive but merely convincing to one skilled in the art.

Applicant may submit factual affidavits under 37 CFR 1.132 or cite references to show what one skilled in the art knew at the time of filing the application. <u>A declaration or affidavit is, itself, evidence that must be considered.</u> The weight to give a declaration or affidavit will depend upon the amount of factual evidence the declaration or affidavit contains to support the conclusion of enablement. In re Buchner, 929 F.2d 660, 661, 18 USPQ2d 1331, 1332 (Fed. Cir. 1991) ("expert's opinion on the ultimate legal conclusion must be supported by something more than a conclusory statement"); cf. In re Alton, 76 F.3d 1168, 1174, 37 USPQ2d 1578, 1583 (Fed. Cir. 1996) (declarations relating to the written description requirement should have been considered).

* * *

The examiner must then weigh all the evidence before him or her, including the specification and any new evidence supplied by applicant with the evidence and/or sound scientific reasoning previously presented in the rejection and decide whether the claimed invention is enabled. The examiner should **never** make the determination based on personal opinion. The determination should always be based on the weight of all the evidence. (Emphasis in original.)

The Examiner has not followed the procedures outlined in MPEP § 2164.05 since, as previously explained, she still has not properly considered and weighed the totality of experimental evidence of record in this case. Thus, a *prima facie* case of non-enablement has not been made and the burden to show otherwise has not yet shifted to Applicant.

Even if the burden to show enablement is assumed to have shifted, Applicant has provided more than sufficient disclosure of his theory and confirming experimental evidence to meet that burden and convincingly demonstrate enablement of the claimed invention. As discussed above, the standard to be used throughout the prosecution is a preponderance of the totality of the evidence with due consideration to persuasiveness of the arguments.

The Examiner has yet to provide any countervailing evidence supported by facts and credible reasoning that the claimed invention lacks utility. Rather, it appears from the sparse Office Action that the Examiner is improperly relying

upon personal opinion to reject Applicant's claimed invention contrary to the above standard.

The complete lack of any evidence to support the Examiner's position contrasts sharply with the extensive experimental evidence and written description submitted by Applicant that demonstrates the utility and enablement of his claimed invention. Applicant's evidence exceeds the "convincing" standard set forth above. Indeed, the existence of lower-energy hydrogen has been shown by theory and supporting experimental evidence that has been peer-reviewed by Ph.D scientists and published in prestigious scientific journals.
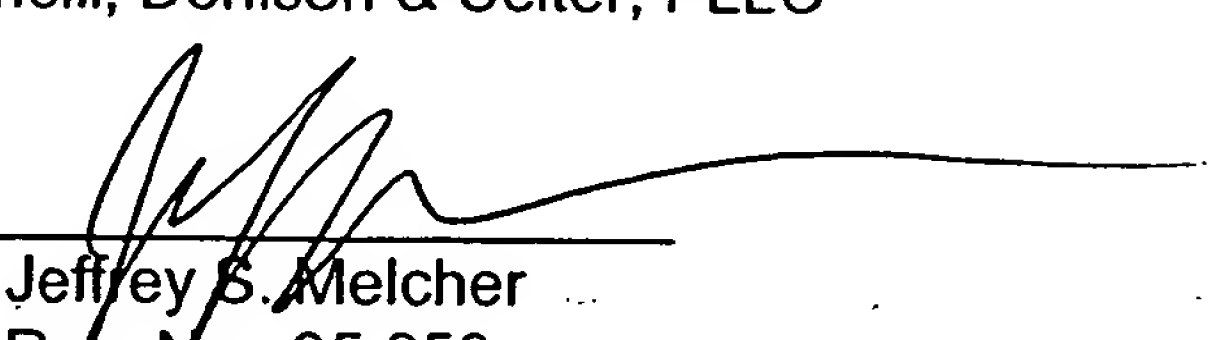
Furthermore, Applicant has disclosed detailed working examples in the present specification that one skilled in the art could easily follow to practice the claimed invention.

For these many reasons, the Section 112, first paragraph, rejection is defective and should be withdrawn.

For all of the foregoing reasons, Applicant submits that the present application is in condition for allowance and Notice to that effect is respectfully requested.

Respectfully submitted,

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ATTACHMENT A

Applicant's Novel Catalytic Reaction of Atomic Hydrogen

Applicant's experimental evidence supporting the formation of lower-energy hydrogen is based, in part, on studies of the disclosed catalytic reaction of atomic hydrogen for producing such lower-energy states as described below:

J. R. Rydberg showed that all of the spectral lines of atomic hydrogen were given by a completely empirical relationship:

$$\bar{v} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$ (1)

where $R = 109,677\ cm^{-1}$, $n_f = 1,2,3,...$, $n_i = 2,3,4,...$ and $n_i > n_f$. Bohr, Schrodinger, and Heisenberg each developed a theory for atomic hydrogen that gave the energy levels in agreement with Rydberg's equation.

$$E_n = -\frac{e^2}{n^2 8\pi\varepsilon_o a_H} = -\frac{13.598\ eV}{n^2}$$ (2a)

$$n = 1,2,3,...$$ (2b)

The excited energy states of atomic hydrogen are given by Eq. (2a) for $n > 1$ in Eq. (2b). The $n = 1$ state is the "ground" state for "pure" photon transitions (i.e., the $n = 1$ state can absorb a photon and go to an excited electronic state, but it cannot release a photon and go to a lower-energy electronic state). However, an electron transition from the ground state to a lower-energy state may be possible by a resonant nonradiative energy transfer such as multipole coupling or a resonant collision mechanism. Processes such as hydrogen molecular bond formation that occur without photons and that require collisions are common.[35] Also, some commercial phosphors are based on resonant nonradiative energy transfer involving multipole coupling.[36]

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[35] Reference 49. Note that a complete list of the references is provided at the end of this Attachment, titled Attachment B.

[36] Reference 50.

Applicant proposes that atomic hydrogen may undergo a catalytic reaction with certain atoms and ions such as He^+ which singly or multiply ionize at integer multiples of the potential energy of atomic hydrogen, $m \cdot 27.2 \ eV$ wherein m is an integer. The reaction involves a nonradiative energy transfer to form a hydrogen atom that is lower in energy than unreacted atomic hydrogen that corresponds to a fractional principal quantum number. That is

$$n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, ..., \frac{1}{p}; \quad p \text{ is an integer} \tag{2c}$$

replaces the well-known parameter $n = \text{integer}$ in the Rydberg equation for hydrogen excited states. The $n = 1$ state of hydrogen and the $n = \frac{1}{\text{integer}}$ states of hydrogen are nonradiative, but a transition between two nonradiative states is possible via a nonradiative energy transfer, say $n = 1$ to $n = 1/2$. Thus, a catalyst provides a net positive enthalpy of reaction of $m \cdot 27.2 \ eV$ (i.e., it resonantly accepts the nonradiative energy transfer from hydrogen atoms and releases the energy to the surroundings to affect electronic transitions to fractional quantum energy levels). As a consequence of the nonradiative energy transfer, the hydrogen atom becomes unstable and emits further energy until it achieves a lower-energy nonradiative state having a principal energy level given by Eqs. (2a) and (2c).

Summary of Analytical Studies Experimentally Confirming the Formation of Lower-Energy Hydrogen

The central issue facing Examiner is whether Applicant's disclosed catalytic reaction does, in fact, form lower-energy hydrogen, i.e., hydrinos, as predicted by his underlying theory.

Had the Examiner properly considered the experimental evidence already of record confirming the existence of lower-energy hydrogen, the Examiner would not have arbitrarily concluded that Applicant's theory

predicting such lower energy states was "not credible." At the risk of having the Examiner continue to ignore such evidence, Applicant presents further argument as to why that record evidence, as well as additional supporting evidence submitted herewith, demonstrates the existence of lower-energy hydrogen.

Applicant has now submitted a multitude of analytical studies experimentally confirming the disclosed novel reaction of atomic hydrogen, which produces hydrogen in fractional quantum states that are at lower energies than the traditional "ground" $(n = 1)$ state, a chemically generated or assisted plasma (rt-plasma), and novel hydrino hydride compounds. These studies fall into the following general categories:

extreme ultraviolet (EUV) spectroscopy,[37]

characteristic emission from catalysis and the hydride ion products,[38]
lower-energy hydrogen emission,[39]

plasma formation,[40]

Balmer α line broadening,[41]

elevated electron temperature,[42]

anomalous plasma afterglow duration,[43]

power generation,[44] and

analysis of chemical compounds.[45]

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[37] References 1, 2, 12-18, 20-22, 25, 29, 33-35, 37, and 38.

[38] References 7, 10, 11, 17, 22, and 25.

[39] References 13-16, 20, and 21.

[40] References 1, 2, 7, 10, 17, 22, 25, 29, 33-34, and 36-38.

[41] References 2, 5, 7, 10, 12-16, 19, and 29.

[42] References 2, 5, and 12-15.

[43] References 36-37.

[44] References 5, 10, 14-16, 18-19, 24, 26, and 46-48.

Per review

All of these studies conclusively demonstrate the existence of hydrinos by different means. Once again, Applicant reminds the Examiner that all such experimental evidence and written discussion relating to the existence of lower-energy hydrogen must be considered, since that information directly refutes the Examiner's stated position to the contrary. Otherwise, it would be blatantly unfair for the Examiner, on the one hand, to allege that lower-energy hydrogen does not exist, yet on the other hand, feel free to ignore any evidence to the contrary. Applicant can hardly imagine a more arbitrary and capricious approach to the examination process than that.

Despite these failings, Applicant presents additional good faith arguments demonstrating how his experimental data – evidence already of record and newly submitted evidence – confirms the existence of lower-energy hydrogen.

One skilled in the art would readily understand and be able to reproduce the real-world analytical studies, including the specific 42 types of studies of Applicant's lower-energy hydrogen technology that have now been made of record in this case. Thirty-four of these corresponding papers have been peer-reviewed and published in scientific Journals. These Journals did not merely publish what Applicant submitted. Rather, the Editor sent out Applicant's submissions to top PhD experts in the field, who were exhaustive in their research, requiring Applicant to conduct further extensive analyses, experimental controls, and additional experiments to further confirm the reported results and conclusions. For those test results that have not yet been peer-reviewed, Applicant verifies those test results by the three Rule 132 Declarations submitted in Attachment A.

For the Examiner's convenience, Applicant summarizes the extensive experimental evidence of record as follows:

(1) the observation of intense extreme ultraviolet (EUV) emission at low temperatures (e.g. $\approx 10^3 \, K$) from atomic hydrogen and only those atomized

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[45] References 3, 4, 11, 24, 30, and 40-44.

elements or gaseous ions which provide a net enthalpy of reaction of approximately $m \cdot 27.2\ eV$ via the ionization of t electrons to a continuum energy level where t and m are each an integer (e.g. K, Cs, and Sr atoms and Rb^+ ion ionize at integer multiples of the potential energy of atomic hydrogen and caused emission; whereas, the chemically similar atoms, Na, Mg, and Ba, do not ionize at integer multiples of the potential energy of atomic hydrogen and caused no emission);[46]

(2) the observation of novel EUV emission lines from microwave and glow discharges of helium with 2% hydrogen with energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,11,12$ or these lines inelastically scattered by helium atoms in the excitation of $He\,(1s^2)$ to $He\,(1s^1 2p^1)$ that were identified as hydrogen transitions to electronic energy levels below the "ground" state corresponding to fractional quantum numbers;[47]

(3) the observation of novel EUV emission lines from microwave and glow discharges of helium with 2% hydrogen at 44.2 nm and 40.5 nm with energies of

$$q \cdot 13.6 + \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right) X 13.6\ eV$$

where $q = 2$ and $n_f = 2,4$ $n_i = \infty$ that corresponded to multipole coupling to give two photon emission from a continuum excited state atom and an atom undergoing fractional Rydberg state transition;[48]

(4) the identification of transitions of atomic hydrogen to lower energy levels corresponding to lower-energy hydrogen atoms in the extreme ultraviolet emission spectrum from interstellar medium and the sun;[49]

(5) the EUV spectroscopic observation of lines by the Institut fur Niedertemperatur-Plasmaphysik e.V. that could be assigned to transitions of atomic hydrogen to lower energy levels corresponding to fractional principal

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[46] References 1, 2, 7, 10, 17, 22, 25, 29, 33-34, and 36-38.

[47] References 13-16, and 21.

[48] Reference 13.

[49] References 20-21, 32, 45.

quantum numbers and the emission from the excitation of the corresponding hydride ions;[50]

(6) the recent analysis of mobility and spectroscopy data of individual electrons in liquid helium which shows direct experimental confirmation that electrons may have fractional principal quantum energy levels;[51]

(7) the observation of novel EUV emission lines from microwave discharges of argon or helium with 10% hydrogen that matched those predicted for vibrational transitions of $H_2^*[n=1/4; n^*=2]^+$ with energies of $\upsilon \cdot 1.185\ eV$, $\upsilon = 17\ to\ 38$ that terminated at the predicted dissociation limit, E_D, of $H_2[n=1/4]^+$, $E_D = 42.88\ eV\ (28.92\ nm)$;[52]

(8) the observation of continuum state emission of Cs^{2+} and Ar^{2+} at $53.3\ nm$ and $45.6\ nm$, respectively, with the absence of the other corresponding Rydberg series of lines from these species which confirmed the resonant nonradiative energy transfer of $27.2\ eV$ from atomic hydrogen to the catalysts atomic Cs or Ar^+;[53]

(9) the spectroscopic observation of the predicted hydride ion $H^-(1/2)$ of hydrogen catalysis by either Cs atom or Ar^+ catalyst at $407\ nm$ corresponding to its predicted binding energy of $3.05\ eV$;[54]

(10) the observation of characteristic emission from K^{3+} which confirmed the resonant nonradiative energy transfer of $3 \cdot 27.2\ eV$ from atomic hydrogen to atomic K;[55]

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[50] Reference 35.

[51] Reference 32.

[52] Reference 20.

[53] Reference 25.

[54] Reference 25.

[55] Reference 22.

(11) the spectroscopic observation of the predicted $H^-(1/4)$ ion of hydrogen catalysis by K catalyst at 110 nm corresponding to its predicted binding energy of 11.2 eV;[56]

(12) the observation of characteristic emission from Rb^{2+} which confirmed the resonant nonradiative energy transfer of 27.2 eV from atomic hydrogen to Rb^+;[57]

(13) the spectroscopic observation of the predicted $H^-(1/2)$ ion of hydrogen catalysis by Rb^+ catalyst at 407 nm corresponding to its predicted binding energy of 3.05 eV;[58]

(14) the high-resolution visible spectroscopic observation from rt-plasmas and plasma electrolysis cells of the predicted $H^-(1/2)$ ion of hydrogen catalysis by each of K^+/K^+, Rb^+, Cs, and Ar^+ at 407 nm corresponding to its predicted binding energy of 3.05 eV;[59]

(15) the observation of $H^-(1/2)$, the hydride ion catalyst product of K^+/K^+ or Rb^+, by high-resolution visible spectroscopy as a broad peak at 407.00 nm with a FWHM of 0.14 nm corresponding to its predicted binding energy of 3.0468 eV;[60]

(16) the observation that the high resolution visible plasma emission spectra in the region of 400.0 nm to 406.0 nm matched the predicted bound-free hyperfine structure lines E_{HF} of $H^-(1/2)$ calculated from the electron g factor as $E_{HF} = j^2 3.0056 X 10^{-5} + 3.0575$ eV (j is an integer) for $j = 1$ to $j = 37$ to within a 1 part per 10^5;[61]

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[56] References 7 and 22.

[57] Reference 17.

[58] Reference 17.

[59] References 2, 7, 10-11, 17, 22, and 25.

[60] Reference 2 and 7.

[61] References 2 and 7.

(17) Rb^+ or $2K^+$ catalysts formed a plasma having strong VUV emission with a stationary inverted Lyman population and emission from $H^-(1/2)$ was observed at 4070.0 Å corresponding to its predicted binding energy of 3.0468 eV with its predicted bound-free hyperfine structure lines $E_{HF} = j^2 3.0056 \times 10^{-5} + 3.0575 \ eV$ (j is an integer) that matched for $j = 1$ to $j = 37$ to within a 1 part per 10^5;[62]

(18) the observation by the Institut fur Niedertemperatur-Plasmaphysik e.V. of an anomalous plasma and plasma afterglow duration formed with hydrogen-potassium mixtures;[63]

(19) the observation of anomalous afterglow durations of plasmas formed by catalysts providing a net enthalpy of reaction within thermal energies of $m \cdot 27.28 \ eV$;[64]

(20) the observation of Lyman series in the EUV that represents an energy release about 10 times that of hydrogen combustion which is greater than that of any possible known chemical reaction;[65]

(21) the observation of line emission by the Institut fur Niedertemperatur-Plasmaphysik e.V. with a 4° grazing incidence EUV spectrometer that was 100 times more energetic than the combustion of hydrogen;[66]

(22) the observation of anomalous plasmas formed with Sr and Ar^+ catalysts at 1% of the theoretical or prior known voltage requirement with a light output per unit power input up to 8600 times that of the control standard light source;[67]

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[62] Reference 2.

[63] Reference 1, 36.

[64] Reference 1, 36-37.

[65] References 1, 2, 7, 10, 17, 22, 25, 29, 33-34, and 36-38.

[66] Reference 35.

[67] References 26, 29, 33, and 38.

(23) the observation that the optically measured output power of gas cells for power supplied to the glow discharge increased by over two orders of magnitude depending on the presence of less than 1% partial pressure of certain catalysts in hydrogen gas or argon-hydrogen gas mixtures, and an excess thermal balance of 42 W was measured for the 97% argon and 3% hydrogen mixture versus argon plasma alone;[68]

(24) the observation that glow discharge plasmas of the catalyst-hydrogen mixtures of strontium-hydrogen, helium-hydrogen, argon-hydrogen, strontium-helium-hydrogen, and strontium-argon-hydrogen showed significant Balmer α line broadening corresponding to an average hydrogen atom temperature of $25 - 45\ eV$; whereas, plasmas of the noncatalyst-hydrogen mixtures of pure hydrogen, krypton-hydrogen, xenon-hydrogen, and magnesium-hydrogen showed no excessive broadening corresponding to an average hydrogen atom temperature of $\approx 3\ eV$;[69]

(25) the observation that microwave helium-hydrogen and argon-hydrogen plasmas having catalyst Ar^+ or He^+ showed extraordinary Balmer α line broadening due to hydrogen catalysis corresponding to an average hydrogen atom temperature of $110 - 130\ eV$ and $180 - 210\ eV$, respectively; whereas, plasmas of pure hydrogen, neon-hydrogen, krypton-hydrogen, and xenon-hydrogen showed no excessive broadening corresponding to an average hydrogen atom temperature of $\approx 3\ eV$;[70]

(26) the observation that microwave helium-hydrogen and argon-hydrogen plasmas showed average electron temperatures that were high, 28,000 K and 11,600 K, respectively; whereas, the corresponding temperatures of helium and argon alone were only 6800 K and 4800 K, respectively;[71]

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[68] Reference 26.

[69] References 19, 29, and 33.

[70] References 12 and 13.

[71] References 12, 13 and 15.

(27) the observation of significant Balmer α line broadening of 17, 9, 11, 14, *and* 24 *eV* from rt-plasmas of incandescently heated hydrogen with K^+/K^+, Rb^+, cesium, strontium, and strontium with Ar^+ catalysts, respectively, wherein the results could not be explained by Stark or thermal broadening or electric field acceleration of charged species since the measured field of the incandescent heater was extremely weak, 1 V/cm, corresponding to a broadening of much less than 1 eV;[72]

(28) calorimetric measurement of excess power of 20 mW/cc on rt-plasmas formed by heating hydrogen with K^+/K^+ and Ar^+ as catalysts;[73]

(29) the Calvet calorimetry measurement of an energy balance of over $-151,000$ $kJ/mole\,H_2$ with the addition of 3% hydrogen to a plasma of argon having the catalyst Ar^+ compared to the enthalpy of combustion of hydrogen of -241.8 $kJ/mole\,H_2$; whereas, under identical conditions no change in the Calvet voltage was observed when hydrogen was added to a plasma of noncatalyst xenon;[74]

(30) the observation that the power output exceeded the power supplied to a hydrogen glow discharge plasmas by 35-184 W depending on the presence of catalysts from helium or argon and less than 1% partial pressure of strontium metal in noble gas-hydrogen mixtures; whereas, the chemically similar noncatalyst krypton had no effect on the power balance;[75]

(31) the observation that with the addition of 3% flowing hydrogen to an argon microwave plasma with an constant input power of 40 W, the gas temperature increased from 400°C to over 750°C; whereas, the 400°C

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[72] Reference 10.

[73] Reference 10.

[74] Reference 18.

[75] Reference 19.

temperature of a xenon plasma run under identical conditions was essentially unchanged with the addition of hydrogen;[76]

(32) the observation that upon the addition of 10% hydrogen to a helium microwave plasma maintained with a constant microwave input power of 40 W, the thermal output power was measured to be at least 400 W corresponding to a reactor temperature rise from room temperature to 1200 °C within 150 seconds, a power density of $40\,MW/m^3$, and an energy balance of at least $-5 \times 10^5\,kJ/mole\,H_2$ compared to the enthalpy of combustion of hydrogen of $-241.8\,kJ/mole\,H_2$;[77]

(33) the differential scanning calorimetry (DSC) measurement of minimum heats of formation of KHI by the catalytic reaction of K with atomic hydrogen and KI that were over $-2000\,kJ/mole\,H_2$ compared to the enthalpy of combustion of hydrogen of $-241.8\,kJ/mole\,H_2$;[78]

(34) the isolation of novel hydrogen compounds as products of the reaction of atomic hydrogen with atoms and ions which formed an anomalous plasma as reported in the EUV studies;[79]

(35) the identification of a novel highly stable surface coating $SiH(1/p)$ by time of flight secondary ion mass spectroscopy that showed SiH^+ in the positive spectrum and H^- dominant in the negative spectrum and by X-ray photoelectron spectroscopy which showed that the H content of the SiH coatings was hydride ions, $H^-(1/4)$, $H^-(1/9)$, and $H^-(1/11)$ corresponding to peaks at 11, 43, and 55 eV, respectively, and showed that the surface was remarkably stable to air;[80]

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[76] Reference 5.

[77] Reference 13.

[78] Reference 24.

[79] References 3, 4, 11, 24, 30, and 40-44.

[80] Reference 3.

(36) the isolation of novel inorganic hydride compounds such as $KH\,KHCO_3$ and KH following each of the electrolysis and plasma electrolysis of a K_2CO_3 electrolyte which comprised high binding energy hydride ions that were stable in water with their identification by methods such as (i) ToF-SIMS on $KH\,KHCO_3$ which showed inorganic hydride clusters $K[KH\,KHCO_3]_n^+$ and a negative ToF-SIMS dominated by hydride ion, (ii) X-ray photoelectron spectroscopy which showed novel peaks corresponding to high binding energy hydride ions, and (iii) proton nuclear magnetic resonance spectroscopy which showed upfield-shifted peaks corresponding to more diamagnetic, high-binding-energy hydride ions;[81]

(37) the identification of $LiHCl$ comprising a high binding energy hydride ion by time of flight secondary ion mass spectroscopy which showed a dominant H^- in the negative ion spectrum, X-ray photoelectron spectroscopy which showed $H^-(1/4)$ as a new peak at its predicted binding energy of 11 eV, ^1H nuclear magnetic resonance spectroscopy which showed an extraordinary upfield-shifted peak of 15.4 ppm corresponding to the novel hydride ion, and powder X-ray diffraction which showed novel peaks;[82]

(38) the identification of novel hydride compounds by a number of analytic methods as such as (i) time of flight secondary ion mass spectroscopy which showed a dominant hydride ion in the negative ion spectrum, (ii) X-ray photoelectron spectroscopy which showed novel hydride peaks and significant shifts of the core levels of the primary elements bound to the novel hydride ions, (iii) ^1H nuclear magnetic resonance spectroscopy (NMR) which showed extraordinary upfield chemical shifts compared to the NMR of the corresponding ordinary hydrides, and iv.) thermal decomposition with analysis by gas

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[81] References 8, 11, 41, 43, and 44.

[82] Reference 4.

chromatography, and mass spectroscopy which identified the compounds as hydrides;[83]

(39) the NMR identification of novel hydride compounds $MH*X$ wherein M is the alkali or alkaline earth metal, X, is a halide, and $H*$ comprises a novel high binding energy hydride ion identified by a large distinct upfield resonance;[84]

(40) the replication of the NMR results of the identification of novel hydride compounds by large distinct upfield resonances at Spectral Data Services, University of Massachusetts Amherst, University of Delaware, Grace Davison, and National Research Council of Canada;[85] and

(41) the NMR identification of novel hydride compounds $MH*$ and MH_2^* wherein M is the alkali or alkaline earth metal and $H*$ comprises a novel high binding energy hydride ion identified by a large distinct upfield resonance that proves the hydride ion is different from the hydride ion of the corresponding known compound of the same composition.[86]

(42) the NMR, TOF-SIMS, XPS identification of novel hydrino hydride compounds and analysis of chemically-produced plasma by an expert hired by the Liebert Corporation, a division of the well-known and highly-respected Emerson Corporation. According to the expert's own words, he "observed demonstrations of the BlackLight Power (BLP) process and . . . reached the inescapable conclusion that it is based on extraordinary chemical reactions that seem to release extraordinary amounts of energy. . . . It is [his] professional opinion that the BLP process represents a chemical conversion of atomic hydrogen unlike any previously reported [in] the archival scientific literature." Although the expert states that he was skeptical of Applicant's theory, he admitted that the chemical and plasma data did support Applicant's fractional

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[83] References 8, 11, 41, and 43.

[84] References 4, 24, 30, 40, and 42.

[85] Reference 30.

[86] Reference 30.

quantum states and that he could offer no other explanation of the data using conventional quantum theory.[87]

Applicant has not only published, or is in the process of publishing, much of his experimental evidence of lower-energy hydrogen, but he has also presented that experimental evidence at the following 27 open forums, which presentations have been well received by Ph.D. scientists:

1. R. Mills, "Novel catalytic reaction of hydrogen as a potential new energy source", Division of Industrial and Engineering Chemistry; Session: Industrial Bio-Based Technology, 222nd American Chemical Society Fall National Meeting, (August 26–30, 2001), Chicago, IL.

2. R. Mills, "Spectroscopic identification of a novel catalytic reaction of hydrogen", Division of Inorganic Chemistry; Session: Catalysis, 222nd American Chemical Society Fall National Meeting, (August 26–30, 2001), Chicago, IL.

3. R. Mills, "Spectroscopic identification of a novel catalytic reaction of hydrogen", Division of Physical Chemistry; Session: Physical Chemistry Poster Session, 222nd American Chemical Society Fall National Meeting, (August 26–30, 2001), Chicago, IL.

4. P. Ray, R. Mills, "Spectroscopic identification of a novel catalytic reaction of hydrogen plasma", Session ET1: Lighting, American Physical Society Meeting, 54th Annual Gaseous Electronics Conference, October 9–12, 2001, Pennsylvania State University, State College, PA.

5. R. Mills, J. He, "Spectroscopic Identification of a Novel Catalytic Reaction of Atomic Hydrogen and the Hydride Ion Product", National Hydrogen Association, 12 th Annual U.S. Hydrogen Meeting and Exposition, *Hydrogen: The Common Thread*, The Washington Hilton and Towers, Washington DC, (March 6-8, 2001).

6. R. Mills, B. Dhandapani, M. Nansteel, N. Greenig, S. Hicks, J. Dong, "Optically Measured Power Balances of Anomalous Discharges of Mixtures of Argon, Hydrogen, and Potassium, Rubidium, Cesium, or Strontium Vapor", National Hydrogen Association, 12 th Annual U.S. Hydrogen Meeting and Exposition, *Hydrogen: The Common Thread*, The Washington Hilton and Towers, Washington DC, (March 6-8, 2001).

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[87] Reference No. 52.

7. R. Mills, M. Nansteel, N. Greenig, S. Hicks, "BlackLight Power Technology-A New Clean Energy Source with the Potential for Direct Conversion to Electricity", National Hydrogen Association, 12 th Annual U.S. Hydrogen Meeting and Exposition, *Hydrogen: The Common Thread*, The Washington Hilton and Towers, Washington DC, (March 6-8, 2001).

8. R. Mills, B. Dhandapani, M. Nansteel, J. He, A. Voigt, "Identification of Compounds Containing Novel Hydride Ions by Nuclear Magnetic Resonance Spectroscopy", National Hydrogen Association, 12 th Annual U.S. Hydrogen Meeting and Exposition, *Hydrogen: The Common Thread*, The Washington Hilton and Towers, Washington DC, (March 6-8, 2001).

9. R. Mills, "BlackLight Power Technology-A New Clean Energy Source with the Potential for Direct Conversion to Electricity", *The 8 th Annual Emerald Groundhog Day Investment Forum*, February 1, 2001, Wyndham Franklin Plaza Hotel, Philadelphia, PA, Organized by Emerald Asset Management, Lancaster, PA.

10. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Global Foundation, Inc. Orbis Scientiae entitled *The Role of Attractive and Repulsive Gravitational Forces in Cosmic Acceleration of Particles The Origin of the Cosmic Gamma Ray Bursts*, (29th Conference on High Energy Physics and Cosmology Since 1964) Dr. Behram N. Kursunoglu, Chairman, December 14-17, 2000, Lago Mar Resort, Fort Lauderdale, FL.

11. R. Mills, "BlackLight Power Technology-A New Clean Energy Source with the Potential for Direct Conversion to Electricity", Global Foundation, Inc. conference entitled *Global Warming and Energy Policy*, Fort Lauderdale, FL, November 26-28, 2000.

12. R. Mills, B. Dhandapani, N. Greenig, J. He, J. Dong, Y. Lu, and H. Conrads, "Formation of an Energetic Plasma and Novel Hydrides from Incandescently Heated Hydrogen Gas with Certain Catalysts", August National ACS Meeting (220th ACS National Meeting, Washington, DC, (August 20-24, 2000)).

13. R. Mills, J. He, and B. Dhandapani, "Novel Alkali and Alkaline Earth Hydrides", August National ACS Meeting (220th ACS National Meeting, Washington, DC, (August 20-24, 2000)).

14. R. Mills, B. Dhandapani, N. Greenig, J. He, J. Dong, Y. Lu, and H. Conrads, "Formation of an Energetic Plasma and Novel Hydrides from Incandescently Heated Hydrogen Gas with Certain Catalysts", June ACS Meeting (29th Northeast Regional Meeting, University of Connecticut, Storrs, CT, (June 18-21, 2000)).

15. Mills, J. Dong, N. Greenig, and Y. Lu, "Observation of Extreme Ultraviolet Hydrogen Emission from Incandescently Heated Hydrogen Gas with Certain Catalysts", 219 th National ACS Meeting, San Francisco, California, (March 26-30, 2000).

16. R. Mills, B. Dhandapani, N. Greenig, J. He, J. Dong, Y. Lu, and H. Conrads, "Formation of an Energetic Plasma and Novel Hydrides from Incandescently Heated Hydrogen Gas with Certain Catalysts", 219 th National ACS Meeting, San Francisco, California, (March 26-30, 2000).

17. R. Mills, "Novel Hydride Compound", 219 th National ACS Meeting, San Francisco, California, (March 26-30, 2000).

18. R. Mills, J. He, and B. Dhandapani, "Novel Alkali and Alkaline Earth Hydrides", 219 th National ACS Meeting, San Francisco, California, (March 26-30, 2000).

19. R. Mills, J. Dong, N. Greenig, and Y. Lu, "Observation of Extreme Ultraviolet Hydrogen Emission from Incandescently Heated Hydrogen Gas with Certain Catalysts", National Hydrogen Association, 11 th Annual U.S. Hydrogen Meeting, Vienna, VA, (February 29-March 2, 2000).

20. R. Mills, B. Dhandapani, N. Greenig, J. He, J. Dong, Y. Lu, and H. Conrads, "Formation of an Energetic Plasma and Novel Hydrides from Incandescently Heated Hydrogen Gas with Certain Catalysts", National Hydrogen Association, 11 th Annual U.S. Hydrogen Meeting, Vienna, VA, (February 29-March 2, 2000).

21. R. Mills, "Novel Hydride Compound", National Hydrogen Association, 11 th Annual U.S. Hydrogen Meeting, Vienna, VA, (February 29-March 2, 2000).

22. R. Mills, J. He, and B. Dhandapani, "Novel Alkali and Alkaline Earth Hydrides", National Hydrogen Association, 11 th Annual U.S. Hydrogen Meeting, Vienna, VA, (February 29-March 2, 2000).

23. R. Mills, J. Dong, Y. Lu, J. Conrads, "Observation of Extreme Ultraviolet Hydrogen Emission from Incandescently Heated Hydrogen Gas with Certain Catalysts", 1999 Pacific Conference on Chemistry and Spectroscopy and the 35th ACS Western Regional Meeting, Ontario Convention Center, California, (October 6-8, 1999).

24. R. Mills, "Novel Hydride Compound", 1999 Pacific Conference on Chemistry and Spectroscopy and the 35th ACS Western Regional Meeting, Ontario Convention Center, California, (October 6-8, 1999).

25. R. Mills, B, Dhandapani, N. Greenig, J. He, "Synthesis and Characterization of Potassium Iodo Hydride", 1999 Pacific Conference on Chemistry and

Spectroscopy and the 35th ACS Western Regional Meeting, Ontario Convention Center, California, (October 6-8, 1999).

26. R. Mills, J. He, and B. Dhandapani, "Novel Hydrogen Compounds", 1999 Pacific Conference on Chemistry and Spectroscopy and the 35th ACS Western Regional Meeting, Ontario Convention Center, California, (October 6-8, 1999).

27. R. Mills, "Excess Heat Production by the Electrolysis of an Aqueous Potassium Carbonate Electrolyte", August 1991 meeting of the American Chemical Society, NY, NY.

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ATTACHMENT B

TABLE OF REFERENCES

Note that the Attachment Nos. referred to in this Attachment B refer to the Attachment Nos. for the articles submitted with Applicant's Response filed January 28, 2002.

1. H. Conrads, R. Mills, Th. Wrubel, "Emission in the Deep Vacuum Ultraviolet from an Incandescently Driven Plasma in a Potassium Carbonate Cell", Plasma Sources Science and Technology, submitted. [Copy provided in Attachment 36]

2. R. L. Mills, P. Ray, "Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Catalysts", International Journal of Engineering Science, submitted. [Copy provided in Attachment 37]

3. R. L. Mills, B. Dhandapani, J. He, "Synthesis and Characterization of a Highly Stable Amorphous Silicon Hydride", Int. J. Hydrogen Energy, in press. [Copy provided in Attachment 38]

4. R. L. Mills, A. Voigt, B. Dhandapani, J. He, "Synthesis and Characterization of Lithium Chloro Hydride", Int. J. Hydrogen Energy, submitted. [Copy provided in Attachment 39]

5. R. L. Mills, P. Ray, "Substantial Changes in the Characteristics of a Microwave Plasma Due to Combining Argon and Hydrogen", New Journal of Physics, www.njp.org, Vol. 4, (2002), pp. 22.1-22.17. [Copy provided in Attachment 40]

6. [Purposely Omitted].

7. R. L. Mills, P. Ray, " A Comprehensive Study of Spectra of the Bound-Free Hyperfine Levels of a Novel Hydride Ion H⁻ (1/2)", Int. J. Hydrogen Energy, in press. [Copy provided in Attachment 41]

8. R. L. Mills, E. Dayalan, "Novel Alkali and Alkaline Earth Hydrides for High Voltage and High Energy Density Batteries", Proceedings of the 17th Annual Battery Conference on Applications and Advances, California State University, Long Beach, CA, (January 15-18, 2002), pp. 1-6. [Copy provided in Attachment 42]

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9. R. Mayo, R. Mills, M. Nansteel, "On the Potential of Direct and MHD Conversion of Power from a Novel Plasma Source to Electricity for Microdistributed Power Applications", IEEE Transactions on Plasma Science, in press. [Copy provided in Attachment 43]

10. R. Mills, P. Ray, J. Dong, M. Nansteel, W. Good, P. Jansson, B. Dhandapani, J. He, "Stationary Inverted Lyman Populations and Free-Free and Bound-Free Emission of Lower-Energy State Hydride Ion Formed by an Exothermic Catalytic Reaction of Atomic Hydrogen and Certain Group I Catalysts", Physical Chemistry Chemical Physics, submitted. [Copy provided in Attachment 44]

11. R. Mills, E. Dayalan, P. Ray, B. Dhandapani, J. He, "Highly Stable Novel Inorganic Hydrides from Aqueous Electrolysis and Plasma Electrolysis", Electrochimica Acta, Vol 47, No. 24 (2002), pp. 3909-3926. [Copy provided in Attachment 45]

12. R. L. Mills, P. Ray, B. Dhandapani, J. He, "Comparison of Excessive Balmer α Line Broadening of Glow Discharge and Microwave Hydrogen Plasmas with Certain Catalysts", J. of Applied Physics, (2002), Vol. 92, No. 12, pp. 7008-7022. [Copy provided in Attachment 46]

13. R. L. Mills, P. Ray, B. Dhandapani, J. He, "Emission Spectroscopic Identification of Fractional Rydberg States of Atomic Hydrogen Formed by a Catalytic Helium-Hydrogen Plasma Reaction", Vacuum, submitted. [Copy provided in Attachment 47]

14. R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "New Power Source from Fractional Rydberg States of Atomic Hydrogen", Optics Communications, submitted. [Copy provided in Attachment 48]

15. R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "Spectroscopic Identification of Transitions of Fractional Rydberg States of Atomic Hydrogen", Quantitative Spectroscopy and Energy Transfer, in press. [Copy provided in Attachment 49]

16. R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "New Power Source from Fractional Quantum Energy Levels of Atomic Hydrogen that Surpasses Internal Combustion", J Mol. Struct., Vol. 643, No. 1-3, (2002), pp. 43-54. [Copy provided in Attachment 50]

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17. R. L. Mills, P. Ray, "Spectroscopic Identification of a Novel Catalytic Reaction of Rubidium Ion with Atomic Hydrogen and the Hydride Ion Product", Int. J. Hydrogen Energy, Vol. 27, No. 9, (2002), pp. 927-935. [Copy provided in Attachment 51]

18. R. Mills, J. Dong, W. Good, P. Ray, J. He, B. Dhandapani, "Measurement of Energy Balances of Noble Gas-Hydrogen Discharge Plasmas Using Calvet Calorimetry", Int. J. Hydrogen Energy, Vol. 27, No. 9, (2002), pp. 967-978. [Copy provided in Attachment 52]

19. R. L. Mills, A. Voigt, P. Ray, M. Nansteel, B. Dhandapani, "Measurement of Hydrogen Balmer α Line Broadening and Thermal Power Balances of Noble Gas-Hydrogen Discharge Plasmas", Int. J. Hydrogen Energy, Vol. 27, No. 6, (2002), pp. 671-685. [Copy provided in Attachment 53]

20. R. Mills, P. Ray, "Vibrational Spectral Emission of Fractional-Principal-Quantum-Energy-Level Hydrogen Molecular Ion", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 533-564. [Copy provided in Attachment 54]

21. R. Mills, P. Ray, "Spectral Emission of Fractional Quantum Energy Levels of Atomic Hydrogen from a Helium-Hydrogen Plasma and the Implications for Dark Matter", Int. J. Hydrogen Energy, Vol. 27, No. 3, (2002) pp. 301-322. [Copy provided in Attachment 55]

22. R. Mills, P. Ray, "Spectroscopic Identification of a Novel Catalytic Reaction of Potassium and Atomic Hydrogen and the Hydride Ion Product", Int. J. Hydrogen Energy, Vol. 27, No. 2, (2002), pp. 183-192. [Copy provided in Attachment 56]

23. R. Mills, "BlackLight Power Technology-A New Clean Hydrogen Energy Source with the Potential for Direct Conversion to Electricity", Proceedings of the National Hydrogen Association, 12 th Annual U.S. Hydrogen Meeting and Exposition, Hydrogen: The Common Thread, The Washington Hilton and Towers, Washington DC, (March 6-8, 2001), pp. 671-697. [Copy provided in Attachment 57]

24. R. Mills, W. Good, A. Voigt, Jinquan Dong, "Minimum Heat of Formation of Potassium Iodo Hydride", Int. J. Hydrogen Energy, Vol. 26, No. 11, (2001), pp. 1199-1208. [Copy provided in Attachment 58]

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25. R. Mills, "Spectroscopic Identification of a Novel Catalytic Reaction of Atomic Hydrogen and the Hydride Ion Product", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1041-1058. [Copy provided in Attachment 59]

26. R. Mills, N. Greenig, S. Hicks, "Optically Measured Power Balances of Glow Discharges of Mixtures of Argon, Hydrogen, and Potassium, Rubidium, Cesium, or Strontium Vapor", Int. J. Hydrogen Energy, Vol. 27, No. 6, (2002), pp. 651-670. [Copy provided in Attachment 60]

27. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Global Foundation, Inc. Orbis Scientiae entitled *The Role of Attractive and Repulsive Gravitational Forces in Cosmic Acceleration of Particles The Origin of the Cosmic Gamma Ray Bursts*, (29th Conference on High Energy Physics and Cosmology Since 1964) Dr. Behram N. Kursunoglu, Chairman, December 14-17, 2000, Lago Mar Resort, Fort Lauderdale, FL, Kluwer Academic/Plenum Publishers, New York, pp. 243-258. [Copy provided in Attachment 61]

28. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590. [Copy provided in Attachment 62]

29. R. Mills and M. Nansteel, P. Ray, "Argon-Hydrogen-Strontium Discharge Light Source", IEEE Transactions on Plasma Science, Vol. 30, No. 2, (2002), pp. 639-635. [Copy provided in Attachment 63]

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31. R. Mills, "BlackLight Power Technology-A New Clean Energy Source with the Potential for Direct Conversion to Electricity", Global Foundation International Conference on "Global Warming and Energy Policy", Dr. Behram N. Kursunoglu, Chairman, Fort Lauderdale, FL, November 26-28, 2000, Kluwer Academic/Plenum Publishers, New York, pp. 187-202. [Copy provided in Attachment 65]

32. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to

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33. R. Mills, M. Nansteel, and Y. Lu, "Excessively Bright Hydrogen-Strontium Plasma Light Source Due to Energy Resonance of Strontium with Hydrogen", J. of Plasma Physics, in press.

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37. R. Mills, T. Onuma, and Y. Lu, "Formation of a Hydrogen Plasma from an Incandescently Heated Hydrogen-Catalyst Gas Mixture with an Anomalous Afterglow Duration", Int. J. Hydrogen Energy, Vol. 26, No. 7, (2001), pp. 749-762. [Copy provided in Attachment 71]

38. R. Mills, M. Nansteel, and Y. Lu, "Observation of Extreme Ultraviolet Hydrogen Emission from Incandescently Heated Hydrogen Gas with Strontium that Produced an Anomalous Optically Measured Power Balance", Int. J. Hydrogen Energy, Vol. 26, No. 4, (2001), pp. 309-326. [Copy provided in Attachment 72]

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51. Keith Keefer, Ph.D., "Interim Report on BlackLight Power Technology: Its Apparent Scientific Basis, State of Development and Suitability for Commercialization by Liebert Corporation." [Copy provided in January 28, 2002 Response]

ATTACHMENT C

In response to the Examiner's criterion that lower-energy hydrogen must have been observed before the Applicant's filing for a patent in order for the Applicant's case to be considered flies in the face of the purpose of patenting. The Examiner is presuming that all discoveries on hydrogen have been made and no new ones exist. The only basis for this absurd argument is that it is not predicted by quantum mechanics (QM). But, the quantum mechanical solution of the hydrogen atom does not rely on any physical principle—only the past data as the basis of a satisfactory solution of a postulated wave equation. No physics is involved—rather a wave operator and wave equation are purely mathematically matched to a series of experimental observed spectral lines with no physical basis as to why those spectral lines exist in the first place.[88] See R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Physics in Perspective, submitted. [Attachment 2] Thus, the Examiner's argument is circular— only the integer states of atomic hydrogen were previously observed; so, a wave equation was postulated and solved in agreement with those lines with the exclusion of the claimed lines since they were not known previously. Then, the discovery of new lines would require that the solution be modified to include them as well. This is easily done as shown previously.[89] To the Applicant's knowledge, no one has ever searched for additional lines.

Quantum mechanics is NOT predictive since it is not based on or in agreement with first principles. It predicts many nonsensical consequences such as unobserved virtual particles, and has many problems as discussed previously.[90] These include the

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[88] Bohr just postulated orbits stable to radiation with the further postulate that the bound electron of the hydrogen atom does not obey Maxwell's equations—rather it obeys different physics. Schrödinger and Dirac both used the Coulomb potential, and Dirac used the vector potential of Maxwell's equations. But, both ignored electrodynamics and the corresponding radiative consequences. Dirac originally attempted to solve the bound electron physically with stability with respect to radiation according to Maxwell's equations with the further constraints that it was relativistically invariant and gave rise to electron spin. See P. Pearle, Foundations of Physics, "Absence of radiationless motions of relativistically rigid classical electron", Vol. 7, Nos. 11/12, (1977), pp. 931-945. He was unsuccessful and resorted to the current mathematical-probability-wave model that has many problems [3-5].

[89] R. Mills, The Nature of Free Electrons in Superfluid Helium—a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory, Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096. **Attachment 66**

[90] R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Physics in Perspective, submitted. **Attachment 2**

fact that QM does not explain the stability of the n=1 state of atomic hydrogen.[91] The patent offices criterion of strict adherence to the current version of QM would have eliminated some of the most important unexpected results in science such as the experimental discovery of electron spin which was in contradiction to the Schrodinger equation, high temperature superconductivity which was in violation of the QM-based BCS theory, fullerenes, and the laser which is in violation of the Heisenberg uncertainty principle as discussed in Applicant's previous office action. Adherence to dogma would also have precluded the discovery of the acceleration of the expansion of the universe in contradiction to Big Bang theory and the consequences of the Michelson-Morley experiment and the Davidson-Germer experiment, to name a few. The Applicant's novel lower-energy hydrogen is predicted from experimentally derived first principle laws and is fully supported by the experimental data which takes precedence over any theory.

R. Mills, The Nature of Free Electrons in Superfluid Helium—a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory, Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096. **Attachment 66**
R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183. **Attachment 78**
R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2002 Edition, BlackLight Power, Inc., Cranbury, posted at www.blacklightpower.com.

[91] R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Physics in Perspective, submitted. **Attachment 2**